ENGINEERING

An Illustrated Weekly Journal

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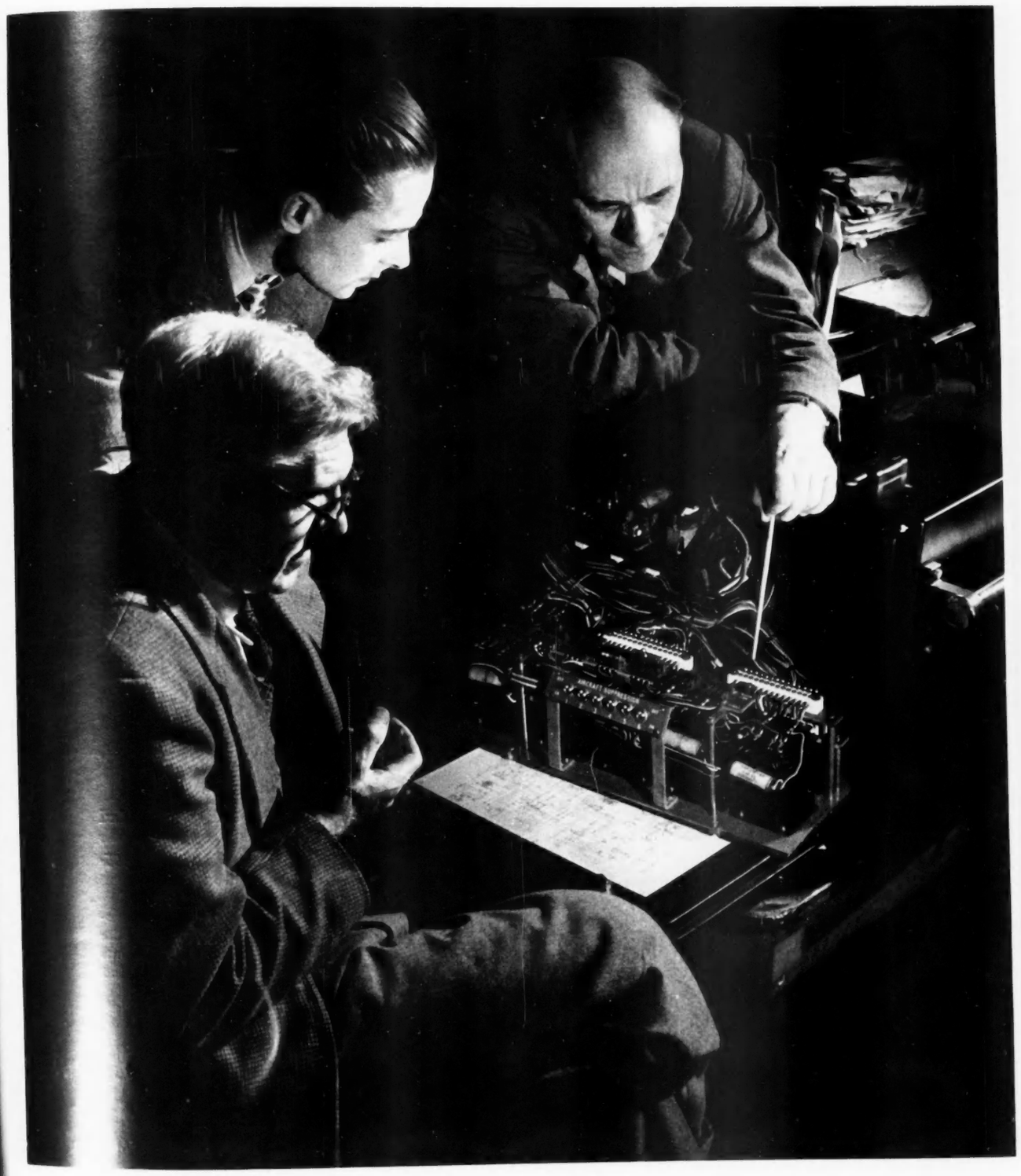
Vol. 181 No. 4698 *LONDON, FRIDAY, FEBRUARY* 10, 1956 PRICE 2s.



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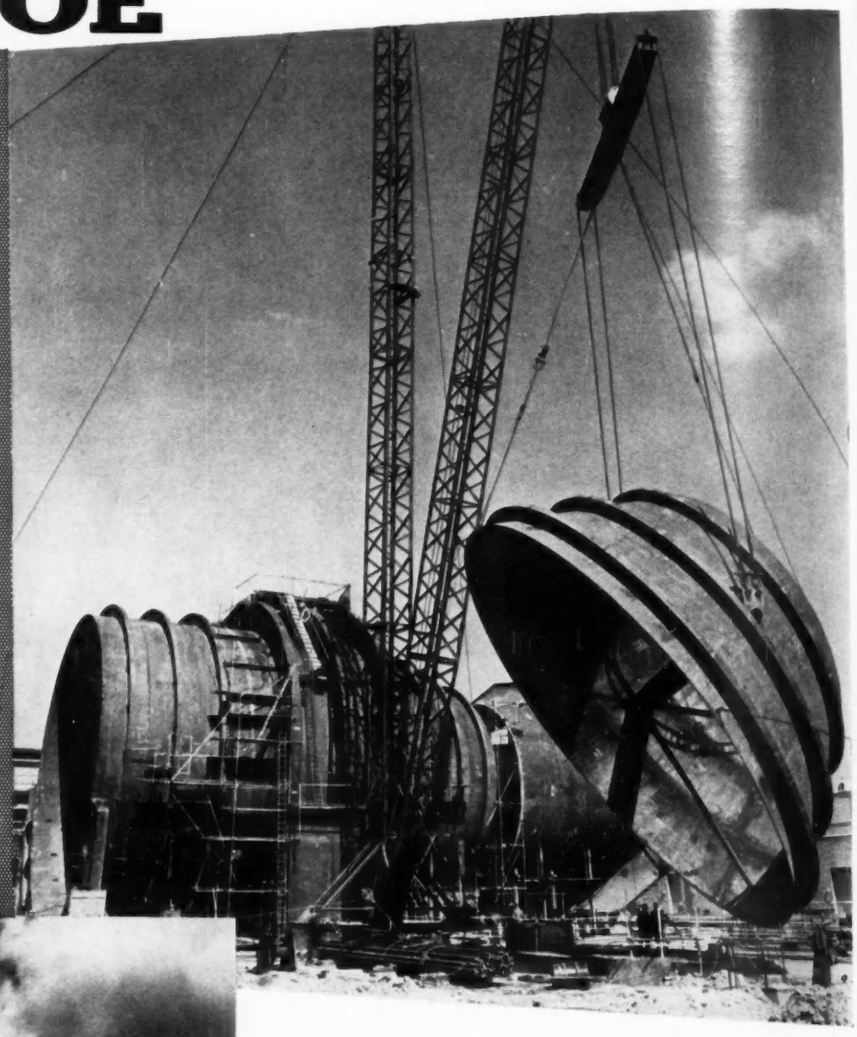
built the major WIND TUNNEL STRUCTURES in steel plate for the NATIONAL AERONAUTICAL ESTABLISHMENT at Bedford



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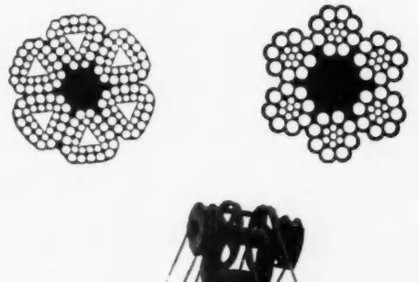

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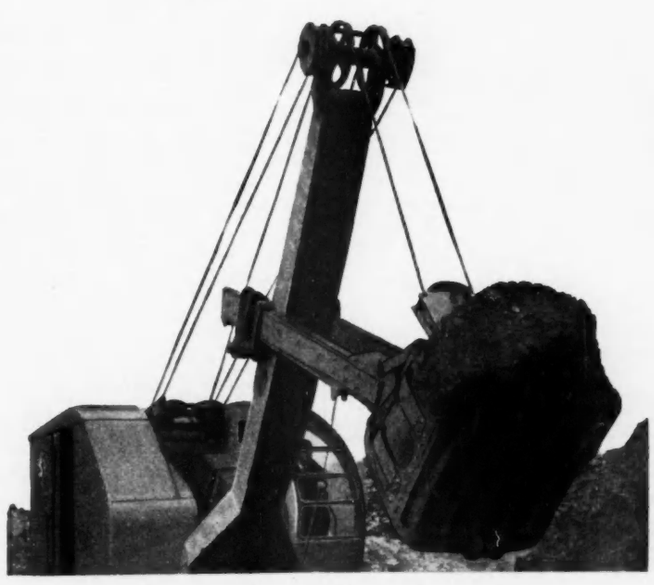

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CLASSIFIED ADVERTISEMENTS SECTION.

For all advertisements classified under the headings of Tenders, Appointments Open, Situations Wanted, Patent Agents, Partnerships, Wanted, &c., Auction Sales, Publications For Sale, Miscellaneous and Public Notices, &c., the charge will be **12s.** for the first four lines or under and **3s.** per line up to one inch. When an advertisement measures an inch or more, the charge will be at the rate of **36s.** per inch. 5% allowed on 6, 10% on 13, 15% on 26 and 20% on 52 Weekly insertions. If use is made of a box number the extra charge is **2s.** per insertion with the exception of advertisements appearing under Situations Wanted. Prospectuses and Notices of Company Meetings £25 per column. Copy instructions must be in our hands first post Monday for the following Friday's issue. Address to the Manager, ENGINEERING LTD., 35 and 36, Bedford St., Strand, W.C.2 Inclusion of advertisements must be dependent on space being available.

PUBLIC NOTICE.

UNIVERSITY OF GLASGOW.

LECTURESHIP IN ELECTRICAL ENGINEERING.

Applications are invited for a **LECTURESHIP IN ELECTRICAL ENGINEERING.** Salary scale: £650 by £50 to £1350. Initial salary according to experience and qualifications. F.S.S.U. and family allowance, benefits. Teaching and industrial experience essential. Special knowledge of one of the following fields is required: Electrical machinery; Vibration Analysis and Engineering Acoustics; Communications (other than Radio).

Applications (8 copies), including the names of three referees, should be lodged not later than 29th February, 1956, with the undersigned, from whom further particulars may be obtained.

ROBT. T. HUTCHESON,
SECRETARY OF UNIVERSITY COURT.
K 329

EDUCATIONAL.

FREE. Brochure giving details of courses in Mechanical and Production Engineering, Draughtsmanship, etc., for the A.M.I.Mech.E., A.M.I.P.E., City and Guilds and other Professional examinations. B.M.I. INSTITUTES, DEPT. EG. 30, LONDON, W.4. (ASSOCIATED WITH H.M.V.). G 619

BURSARY PROVIDED by the NATIONAL BENZOLE CO. for research into the mechanism of engine knock and preignition available for one year in first instance at £400. Work suitable for higher degree. Applications immediately to the PROFESSOR OF MECHANICAL ENGINEERING, IMPERIAL COLLEGE, LONDON, S.W.7. K 305

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY.
DEPARTMENT OF CIVIL ENGINEERING.

BURSARIES IN CONCRETE TECHNOLOGY.

NOTICE IS HEREBY GIVEN that the election to **BURSARIES** in Concrete Technology tenable as from October, 1956, will take place in June, 1956.

Candidates must hold a degree in Engineering at the time of taking up the award, and must also have a good knowledge of the theory of structures.

Bursaries are of the value of £460, out of which the College Tuition Fee of £60 has to be paid; the amount may be increased to a maximum of £760, depending on the qualifications and length and nature of industrial experience. The Bursary is for the normal College session extending from October until the following June.

The course will be postgraduate and Bursars who successfully complete the course will be eligible for the award of the Diploma of the Imperial College (D.I.C.).

Applications must be received on or before 1st June, 1956, by the DEPUTY REGISTRAR, CITY AND GUILDS COLLEGE, EXHIBITION ROAD, LONDON, S.W.7, who will, on written request, send full information and application forms. K 326

POSTAL COURSES.

DETECTION AS USED BY WATER-DIVINERS now has many well-checked applications in the laboratory and the home: time-saving assessments. Ability Test free from A-A-P POSTAL COURSES (EG), STOCK, ESSEX. (ESTD. 1938). K 148

COURSES.

UNIVERSITY COLLEGE LONDON.

A Special Vacation Course on **"UNPUBLISHED RESEARCH MATERIALS IN SCIENCE AND TECHNOLOGY AND THE SOCIAL SCIENCES."** will be held 23-26 April, 1956, for research workers, information officers, and special librarians. For details apply to the DIRECTOR, SCHOOL OF LIBRARIANSHIP & ARCHIVES, UNIVERSITY COLLEGE, LONDON, GOWER STREET, W.C.1. K 341

AGENCIES.

ENGINEERING AGENTS wide experience and excellent connections, are prepared to follow up quotation in the South Wales area.—BOX G 551, Offices of ENGINEERING.

EXPERIMENTAL WORK.

RESEARCH ENGINEERS LIMITED,

Northampton Grove, Canonbury, London, N.1. Canonbury 4244/5/6. We have over 25 years' experience of experimental work and prototypes. We design, develop and manufacture special purpose and labour saving machines, all at the above address. Our range is from the smallest scientific instruments to 3- or 4-ton machines. After a prototype machine has been made and found satisfactory we can manufacture as many as are required in our Works.
G 656

TENDERS.

EPSOM AND EWELL CORPORATION WATER DEPARTMENT.

TENDERS FOR THE SUPPLY OF PLANT.

The Council invite **TENDERS** for the supply and installation of the following plant at the East Street Pumping Station of their Water Undertaking.

CONTRACT NO. 1—SUPPLY AND INSTALLATION OF A 600 H.P. DIESEL ALTERNATOR

CONTRACT NO. 2—SUPPLY AND INSTALLATION OF ELECTRIC MOTORS FOR THE OPERATION OF BOREHOLE AND HIGH LIFT PUMPS OF 110 AND 280 H.P. RESPECTIVELY.

CONTRACT NO. 3—SUPPLY AND INSTALLATION OF THE NECESSARY SWITCHGEAR AND ADAPTATION OF THE EXISTING SWITCHBOARD.

Copies of the Specification and forms of tender may be obtained on application to MR. L. D. EVANS, B.Sc. (Lond), A.M.Inst.C.E., A.M.Inst.W.E. BOROUGH WATER ENGINEER AND MANAGER, WATERWORKS, EAST STREET, EPSOM.

Sealed tenders must be forwarded as directed so as to reach me not later than the 10th March, 1956.

The Council does not bind itself to accept the lowest or any tender.

EDWARD MOORE,
TOWN CLERK.

TOWN HALL,
THE PARADE,
EPSOM. K 315

PUBLIC APPOINTMENTS.

CAMBRIDGESHIRE EDUCATION COMMITTEE.

CAMBRIDGESHIRE TECHNICAL COLLEGE AND SCHOOL OF ART.

Applications are invited for the post of **LECTURER IN PRODUCTION ENGINEERING** to take classes up to Final C.G.L.I. in Machine Shop Engineering and to be responsible for the future development of the Engineering Workshop.

Candidates should have appropriate qualifications, a sound machine shop training and good industrial and teaching experience. Experience in Instrument Making would be an additional recommendation.

The successful applicant will be required to take up his duties on 16th April, or as soon thereafter as possible. Salary will be in accordance with the current Burnham Award for Teachers in Establishments of Further Education, i.e. £965 by £25 to £1065.

Further particulars of the appointment and a form of application may be obtained from the PRINCIPAL, CAMBRIDGESHIRE TECHNICAL COLLEGE AND SCHOOL OF ART, COLLIER ROAD, CAMBRIDGE. K 220

PRESTON.

HARRIS INSTITUTE TECHNICAL COLLEGE.

Applications are invited for the post of **ASSISTANT LECTURER, GRADE B,** in the Mechanical Engineering Department.

Candidates should possess a Degree or equivalent qualification and should have had good practical experience.

Ability to teach such subjects as Workshop Technology, Machine Tools, Metrology and Jig and Tool Design to Higher National Certificate level is desirable.

Forms of application may be obtained from the undersigned, TECHNICAL COLLEGE, CORPORATION STREET, PRESTON, to whom they should be returned within 14 days from the appearance of this advertisement.

H. WILKINSON,
Principal and Secretary. K 201

TECHNICIANS

required by

THE ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, BERKS,

to act as members of a shift pool supervising industrial staff engaged in operation and maintenance of electrical and mechanical plant and equipment. Duties will include the routine inspection of essential items of equipment involving in some cases the wearing of Protective clothing and maintaining technical records. The plant includes electric power and lighting equipment, air extraction plant, hot water heating system, domestic services, automatic controls and alarms.

Applicants should have served a recognised engineering apprenticeship. They should have a working knowledge of at least some of the equipment involved. Experience on engineering shift work in charge of ventilation plant and domestic services would be advantageous. Possession of O.N.C. or equivalent qualification is desirable.

SALARY.

£743-£873 p.a. Contributory Superannuation Scheme. Married officers now living outside the Establishment's transport area will be eligible for housing on one of the Authority's estates, alternatively assistance towards legal expenses incurred in house purchase may be available, until housed a lodging allowance may be payable.

Requests for application forms by POSTCARD to SENIOR RECRUITMENT OFFICER at the above address, quoting reference number S17/26. K 359

CENTRAL ELECTRICITY AUTHORITY.

NORTH WEST, MERSEYSIDE & NORTH WALES DIVISION.

Vacancy No. E.353/32.E.—**SENIOR DRAUGHTSMAN (MECH.).** GENERATION (CONSTRUCTION) DEPARTMENT, ALLERTON, LIVERPOOL. Experience in a drawing office associated with construction of modern power stations and/or plant manufacturing works will be an advantage. Salary £640/740 (D.5).

Applications, giving details of age and experience, to DIVISIONAL SECRETARY, CENTRAL ELECTRICITY HOUSE, 825, WILMSLOW ROAD, MANCHESTER, 20, before 18th February. Quote Vacancy No. K 362

ADMIRALTY.
ROYAL NAVAL SCIENTIFIC SERVICE.

DRAUGHTSMEN required in Admiralty Research and Development Establishments in London (Teddington area), Portsmouth, Weymouth, and Baldock (Herts) for the design of experimental apparatus needed for fundamental research or for fitting in H.M. ships. Experience is necessary in any of the following classes of equipment: light to medium electrical, electro-mechanical, precision mechanical and electronic.

Candidates must be British aged 21 years or over, with at least 3 years' practical workshop training and, preferably, with drawing office experience and/or possession of the O.N.C. or equivalent.

Appointments unestablished, but opportunities will occur to compete for established posts and for promotion.

Starting pay (London rate), £463 10s. per annum (aged 21), £635 (aged 28) rising by 4 increments to £725 per annum; slightly less in the Provinces.

Apply stating age, training, experience and qualifications to ADMIRALTY, SANCTUARY BUILDINGS (ROOM 151), GREAT SMITH STREET, LONDON, S.W.1. G 636

The Industrial Group of THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY has vacancies at Risley for **SENIOR ENGINEERS** in its Design Offices, which are engaged on an expanding programme of industrial applications of nuclear energy. Very large projects are involved, such as nuclear power reactors and their associated chemical and physical process plants. A design office has an overall responsibility normally for one such project at a time. Designs are made in close collaboration with development and research groups and assistance is given by specialised engineering and commercial branches. The design office maintains close contact with manufacture and site construction. A Chief Engineer is responsible for a design office, and has a Deputy Chief Engineer and several Assistant Chief Engineers carrying responsibility for the whole range of duties covering specific parts of the project. While much of the work is novel, previous experience of nuclear engineering is not essential and a sound training in mechanical or chemical engineering with considerable experience of high quality design work in one of these fields, and good technical judgement will enable an engineer quickly to take an effective part in the work.

The Authority would be interested to hear from Engineers with the special qualifications and wide experience of large engineering projects enabling them to undertake the duties of Chief Engineer as described above. Salaries would reflect the very substantial responsibilities of these posts. There are also a number of vacancies as Deputy Chief Engineer and Assistant Chief Engineer, affording opportunities in this new and essential industry. Salaries are in the ranges £2200-£2700 and £1700-£2200 respectively.

Applicants in all cases should be corporate members of a Senior Engineering Institution; or possess an honours degree in mechanical or chemical engineering and have served an engineering apprenticeship or pupilage.

Those qualified and interested should write to: W. L. OWEN, C.B.E., M.Eng., M.I.C.E., M.I.Mech.E. M.I.Chem.E., DIRECTOR OF ENGINEERING, UNITED KINGDOM ATOMIC ENERGY AUTHORITY, RISLEY, LANCASHIRE. K 192

CENTRAL ELECTRICITY AUTHORITY NUCLEAR POWER BRANCH

Applications are invited for the following appointments in the Nuclear System Engineering Section of the Nuclear Development Sub-Branch for work on theoretical and economic aspects and the longer term applications of nuclear power. The successful candidates will be located at Bankside House, London, S.E.1.

Candidates who have previously applied for appointments in this Branch must make a fresh application if they wish to be considered for the posts listed below.

ND.1. **SENIOR ASSISTANT ENGINEER.**
To deal with engineering problems arising in the consideration of future reactors, to collaborate with others working on the associated problems in reactor physics, engineering materials and steam plant, and to assist the Head of the Section in the work of making overall assessments of possible future nuclear power plants.
Candidates should preferably have an Honours Degree in Engineering and/or be Corporate Members of one of the senior Institutions. They should also have experience of design and development work.
The successful candidate may be required to attend a course at the Harwell Reactor School, and to undergo a short training period with the Industrial Group of the U.K.A.E.A. before taking up his appointment in London.

ND.2. **SENIOR ASSISTANT ENGINEER**
To handle the investigations of possible steam cycles and steam plant for use in conjunction with future power reactors.
Candidates should preferably have a Degree in Engineering and/or be Corporate Members of the Institution of Mechanical Engineers. They should also have experience in the design or development of steam power plant.

ND.3. **SECOND ASSISTANT ENGINEER**
To assist the Senior Assistant Engineer (Ref. ND.1) with particular reference to the investigation of heat transfer and fluid flow problems in the reactor core and coolant circuits.
Candidates should preferably have a Degree in Engineering and/or be Corporate Members of the Institution of Mechanical Engineers. They should also have experience of design or development work. Experience of heat transfer calculations would be an advantage.

ND.4. **SECOND ASSISTANT ENGINEER**
To assist the Senior Assistant Engineer (Ref. ND.2).
Candidates should preferably have a Degree in Engineering and/or be Corporate Members of one of the senior Institutions. They should also have experience of design or development work.

ND.5. **THIRD ASSISTANT ENGINEER**
To assist the Senior Assistant Engineer (Ref. ND.1).
Candidates should preferably have a degree or Higher National Certificate in Engineering and some practical experience.
Salaries within Grades 1, 2 and 3 of Schedule "C" of the N.J.B. Agreement:—
Senior Assistant, NJB 1.—£1150-£1500
Second Assistant, NJB 2.—£971-£1325
Third Assistant, NJB 3.—£908-£1125.
} inclusive of London Allowance.
Applications specifying the reference number of the particular vacancy in which candidates are interested and stating age, qualifications, experience, present position and salary to D. MOFFAT, DIRECTOR OF ESTABLISHMENTS, WINSLEY STREET, LONDON, W.1, to arrive by 29th February, 1956. K 361

ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL

has a vacancy for an

ENGINEER III in its Engineering Services Division. The work covers an exceedingly wide field, many aspects of which are novel. It includes erection and installation of scientific plant, as well as technical investigations, together with the full range of normal works engineering and industrial management. The officer appointed will assist more senior engineers and will have scope for fitting himself for higher posts in an expanding field in which the advancement prospects for good men are excellent.

Applicants should have corporate membership of either the Institution of Mechanical Engineers or the Institution of Electrical Engineers, or exempting qualifications. Possession of a University degree in Engineering would be an advantage. A sound mechanical engineering background, coupled with the ability to carry out thorough technical investigations, and knowledge and experience in any of the following fields: (i) Chemical Engineering; (ii) Electrical Engineering; (iii) Steam, water and compressed air services, heating, ventilating and air conditioning—are very desirable.

Salary will be assessed according to age, qualifications and experience within the scale: £728 (at age 25)-£1130 p.a.

Contributory superannuation scheme. Five-day week. Excellent working conditions and generous annual leave allowance.

Married officers now living outside the Establishment's transport area will be eligible for housing on one of the Authority's estates, or alternatively, substantial assistance towards legal expenses incurred in house purchase will be available.

Send POST CARD for application form to ESTABLISHMENT OFFICER, A.E.R.E., HARWELL, DIDCOT, BERKS., quoting reference 485. K 290

AIR MINISTRY Works Designs Branch requires (A) in LONDON

(1) DESIGNER DRAUGHTSMEN (ORDER NO. 2308) FOR BULK PETROLEUM STORAGE AND PUMPING INSTALLATIONS experienced in one or more of the following:—(a) storage tank layout and design, (b) pump house and plant layout, (c) development of pipe line schemes (d) hydraulic calculations. Technical training to O.N.C. standard required. Salaries up to £725 p.a.

(2) STRUCTURAL ENGINEERING DESIGNER/DRAUGHTSMEN (ORDER NO. 2304) for reinforced concrete or structural steel with sound technical training and several years varied experience in design/detailing of:—(a) Reinforced concrete construction for all types of buildings, or (b) steel framed sheds, warehouses and similar buildings, and

CIVIL ENGINEERING DESIGNER/DRAUGHTSMEN (ORDER NO. 2305) experienced in one or more of the following branches of engineering:—(a) Earthworks and Stormwater Drainage, (b) Foul Drainage and small disposal works, (c) Water Pumping Treatment and Distribution. Salaries up to £850 p.a.

(B) IN LONDON AND PROVINCES (with liability for overseas service)

ELECTRICAL ENGINEERING DRAUGHTSMEN (ORDER NO. 2307) experience in preparation of schemes for illumination and electrical equipment of buildings or in electrical distribution H.V. and M.V. Technical training to O.N.C. standard or equiv. an advantage. Salaries up to £850 p.a. Starting pay dependent upon age, quals., and experience. Paid overtime. Long term possibilities with pensionable and promotion prospects. Natural born British subjects. Write stating age, quals., employment details including type of work done to any Employment Exchange quoting Borough and relevant Order No. G 624

THE BRITISH HYDROMECHANICS RESEARCH ASSOCIATION is building up a school of experts in fluid mechanics who are to be capable of applying academic knowledge, supplemented by research, to a wide range of industrial problems.

The work is interesting and varied, covering flow problems in the process industries, chemical plant, power station and civil engineering structures, etc.; the scientific investigation of rotodynamic machines, cavitation, the hydraulic transport of coal, high pressure hydraulic machinery, automatic controls, and the physics of sliding surfaces in seals and glands.

A few well paid vacancies (£660 to £1000) are available for **YOUNG HONOURS GRADUATES IN ENGINEERING, PHYSICS OR MATHEMATICS** who can take the initiative in applying scientific fluid mechanics to industrial problems, and who preferably have some facility in the lucid exposition of their work. The work of the staff brings them in close contact with both industry and the Universities and opportunities arise from time to time for transfer to senior positions with the Association's member companies. There are also some vacancies for good research assistants with laboratory experience.

Successful applicants will be eligible to rent new houses or flats in Harlow.

Send full details to DIRECTOR OF RESEARCH, BRITISH HYDROMECHANICS RESEARCH ASSOCIATION, HARLOW, ESSEX. G 612

NATIONAL COUNCIL FOR TECHNOLOGICAL AWARDS.

Applications are invited for the post of **SECRETARY TO THE COUNCIL**, which has been set up by the Minister of Education as an independent body under the Chairmanship of Lord Hives for the purpose of conferring awards in technology on students of technical colleges.

Applicants should be graduates, preferably between the ages of 35 and 45, with a general knowledge of the content, organisation and administration of technical education in this country. Experience in industry will be an advantage.

Salary will be in the range of £1500 to £2000 and the initial salary will be determined in the light of the qualifications and experience of the successful candidate. Arrangements for superannuation will be made.

Applications should be accompanied by the names and addresses of three referees and must be sent not later than 22nd February, 1956, to:

F. G. WARD,
ACTING SECRETARY,
NATIONAL COUNCIL FOR TECHNOLOGICAL AWARDS,
MINISTRY OF EDUCATION,
CURZON STREET,
LONDON, W.1. K 234

THE ROYAL TECHNICAL COLLEGE, GLASGOW.
(Affiliated to the University of Glasgow.)

DEPARTMENT OF CIVIL AND MECHANICAL ENGINEERING.

Applications are invited for
LECTURESHIPS in
(A) HEAT ENGINES.
(B) FLUID MECHANICS.

Candidates should have a good Honours Degree and industrial experience.

The engineering courses are conducted on a sandwich system which leaves the summer term free for research, opportunities for which are exceptionally good. Members of staff are encouraged to carry out research leading to a higher degree.

Salary on scale £650 by £50 to £1350, with superannuation and Family Allowance benefits.

Form of application may be obtained from the SECRETARY. K 256

MINISTRY OF SUPPLY requires **ENGINEER OR CHEMIST** at Harefield, Middlesex, to direct inspection of metallic materials used in guided weapons. QUALIFICATIONS: British of British parents. Must have wide knowledge and experience this type of work. Engineers need recognised engineering apprenticeship and A.M.I.Mech.E. or E.E. or exempting qualifications. Chemists, an Honours Degree in Metallurgy or A.I.M. or equivalent. Salary: Within £675 (age 25)-£1055 p.a.—Application forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting F 31/6A/BG. K 270

THE ELECTRICITY CORPORATION OF NIGERIA

requires the following staff for service in Nigeria. Some of the appointments are pensionable, others are on contract terms with gratuity payable at end of service.

Intending candidates should write to the undernoted address stating which appointment they are interested in, when full details regarding attractive rates of pay and conditions of service, together with an application form, will be forwarded. Please note that all applicants must possess a clean U.K. Motor Driving Licence.

ELECTRICAL ENGINEERS.

Must be corporate members of I.E.E.

OVERHEAD LINESMAN.

A man with first class experience able to work without supervision and at distance from H.Q. Must have proved ability to control labour.

METER TEST ENGINEERS.

With first class experience in laboratory testing of motor and electrical instruments and ability to work alongside and supervise junior staff.

STOREKEEPERS.

With good experience in the electrical supply industry. Knowledge of generating, steam, diesel and distribution stores. Some experience of Shipping and Customs procedure desirable.

ACCOUNTANTS.

One senior post for which the candidate must be Chartered or Incorporated Accountant. The Junior post calls for experience of supply industry accounts up to trial balance.

THE LIAISON OFFICER,
ELECTRICITY CORPORATION OF NIGERIA,
11, MANCHESTER SQUARE,
LONDON, W.1. K 304

NATIONAL COAL BOARD.
SOUTH WESTERN DIVISION.

Applications are invited for the post of **TECHNICAL ASSISTANT** to the Area Mechanical Engineer in the No. 2 (Maesteg) Area. Applicants should have general engineering experience, and possession of a Mechanical Engineering Degree and/or Associate Membership of the Institute of Mechanical Engineers would be an advantage.

Salary, dependent upon qualifications and experience, will be within the range of £650 to £1050 per annum.

Full particulars of age, qualifications, experience and positions held, should be sent to the STAFF DEPARTMENT, NATIONAL COAL BOARD, CAMBRIAN BUILDINGS, MOUNT STUART SQUARE, CARDIFF, by the 16th February, 1956. K 258

GOLD COAST LOCAL CIVIL SERVICE.

EXECUTIVE ENGINEER.

HOUSING DEPARTMENT.

Duties: to undertake structural design of various building projects including reinforced concrete details and construction and maintenance of roads, drains and sewers: Maintenance of constructional plant and equipment: Also responsibility for financial control of funds for such projects.

Appointment on Contract/Gratuity terms Gross emoluments in incremental scale £1030-£2020 p.a. plus gratuity, payable on satisfactory completion of contract, at rate of £37 10s. for each completed period of three months service. Free Passages: Free medical attention: Generous home leave.

Candidates should have either a University degree recognised by the Institution of Civil Engineers and have at least two years' postgraduate experience, or have passed Parts I and II Finals of the A.M.I.C.E. examination or obtained a recognised diploma, and have had not less than five years' experience of civil engineering works including housing and housing administration. Associate Members of the Institution of Municipal Engineers with similar experience will also be considered.

Further particulars on written application to the DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, GREAT SMITH STREET, LONDON, S.W.1. Please give brief details of age, qualifications and experience and quote reference BCD/160/13/03/D5. K 348

AIR MINISTRY require **CIVIL ENGINEERS** for duty in their Works Department for engineering and administrative work on the construction and maintenance of civil engineering and building projects (covering barracks, workshops, runways, roads, water supply, sewage, drainage works, etc.) on R.A.F. and Civil Aviation stations. Appointments carry liability for service overseas and will be in two grades: (a) Main grade, salary scale £1182 to £1527; (b) Assistant grade, £761 to £1182. Salaries somewhat lower in provinces. Lodging allowance payable in certain circumstances for appointments in Assistant Grade. A special allowance of up to £1500 a year according to location is payable in addition to salary during overseas service. Appointments non-pensionable but with long term possibilities. Candidates must normally be natural born British subjects of natural born British parents. Qualifications (Main Grade) must be corporate members of the Institution of Civil Engineers or Institution of Municipal Engineers. A degree in civil engineering would be an advantage, (Assistant Grade) either B.Sc. (Eng.) or equivalent, A.M.I.C.E. or A.M.I.Mun.E. or Parts I and II of the Institution of Civil Engineers or the Testamur of the Institution of Municipal Engineers and have at least two years' civil engineering experience on the staff of a Government Department, Local Authority, or a firm of Consulting Engineers or Contractors of good standing. Initial appointments to locations at or nearest to those specified by applicants arranged as far as possible.—Applications quoting reference E.40/6A (Main Grade) and E.41/6A (Assistant Grade) from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1. K 327

ESSEX.
SOUTH-EAST ESSEX TECHNICAL COLLEGE AND SCHOOL OF ART,
LONGBRIDGE ROAD, DAGENHAM.

APPLICATIONS invited for post of **HEAD OF ENGINEERING DEPARTMENT** (Burnham Further Education Report Grade IV). Applicants should possess a good engineering degree and have had suitable industrial teaching and administrative experience.

Salary: £1365 by £25 to £1515 (man), plus £36 or £48 London Allowance.

Details and forms (stamped addressed foolscap envelope) obtainable from the CHIEF EDUCATION OFFICER, COUNTY OFFICES, CHELMSFORD. Closing date, 18th February, 1956. K 309

ASSISTANT CHIEF ENGINEERS

Vacancies exist with the INDUSTRIAL GROUP OF THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY IN THE SUPPLY BRANCH AT RISLEY, NR. WARRINGTON.

DUTIES: The technical control and administration of the Supply group. The estimating of costs of construction of large and complicated engineering projects; the standardisation of all engineering materials and recommending of the level of stocks of such stores, together with the writing of specifications for these standard items, and the negotiation of capacity for the production, fabrication and installation of the various types of plant which may be required, including the writing of specifications and technical contract conditions.

QUALIFICATIONS AND EXPERIENCE: Applicants must have served a recognised engineering apprenticeship, and have a degree in engineering or Corporate Membership of the Institutions of Civil, Mechanical or Electrical Engineers. They must be experienced in negotiating contracts for complicated engineering plant and equipment and have a comprehensive knowledge of the engineering markets and sources of supply of raw materials. The successful candidates will be required to discuss requirements at the highest level and an up-to-date knowledge of production and fabrication methods is therefore essential.

SALARY: Will be assessed within the range £1700-£2200 p.a.

The successful candidates if under 55 will be required to join the Authority's contributory pension scheme, which includes Widows' and Dependants' benefits.

Suitably qualified persons are invited to write quoting reference 1281 to SENIOR RECRUITMENT OFFICER, U.K.A.E.A., L.G. H.Q., RISLEY, NR. WARRINGTON. Closing date 17th February, 1956. K 309

THE ROYAL TECHNICAL COLLEGE, GLASGOW.
(In affiliation with the University of Glasgow.)
Department of Civil and Mechanical Engineering.

SENIOR LECTURESHIP IN NUCLEAR POWER ENGINEERING.

Applicants should have a good Honours Degree and design experience in Nuclear Power Plant.

Salary Scale: £1400 by £50 to £1700 with Superannuation and Family Allowance benefits.

Further particulars and Application Forms can be obtained from the SECRETARY, THE ROYAL TECHNICAL COLLEGE, GLASGOW. K 255

HER MAJESTY'S OVERSEA CIVIL SERVICE

MECHANICAL ENGINEER.

P.W.D., NYASALAND.

Executive and supervisory duties concerned with technical aspects of Public Works Department plant and transport organisation, including field maintenance of wide range of contractors' plant and vehicles, organisation of workshops, inspections, costing.

Appointment pensionable, salary range £787-£1710 10s. gross. Free passages for officer, wife and assisted passages for children up to the cost of one adult passage. Government quarters, when available, at 8½ per cent. of salary, maximum £150 per annum. Five days leave for each month of resident service.

Candidates, aged 30-35, should be A.M.I.Mech.E. with at least five years' practical experience in mechanical workshops in an executive capacity.

Apply in writing to the DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, GREAT SMITH STREET, LONDON, S.W.1, giving briefly age, qualifications and experience. Mention the reference number BCD 112/4/019). K 347

Several vacancies exist for **GRADUATE PHYSICISTS, ELECTRICAL ENGINEERS, MECHANICAL ENGINEERS AND A CHEMIST.** There is scope for those recently qualified, or who expect to be shortly, and those with some experience up to age 30. Interesting and varied work in research problems as applied to instruments. Included are amplifying and photo-conducting semi-conductors, automatic control systems, electronic circuits, thermionic devices, electrical contacts, flow measurement, analysis and design in process control systems, glass grinding techniques, tropicalisation. Attractive working conditions in semi-rural surroundings but easy access to London.—Apply, in writing, to the BRITISH SCIENTIFIC INSTRUMENT RESEARCH ASSOCIATION, SOUTH HILL, CHISLEHURST, KENT. K 356

IRRIGATION ENGINEERS—
NORTHERN NIGERIA.

CIVIL ENGINEERS are required by the AGRICULTURAL DEPARTMENT for duties in connection with investigation, design and construction of water control projects, comprising flood protection schemes, storage, reservoirs with distributing systems, reclamation of swamps and marshes, and control of streams.

Appointments either on probation for permanent and pensionable establishment with gross emoluments ranging from £1086-£1680 p.a. or on contract/gratuity terms with gross emoluments ranging from £1290-£1956 p.a. plus gratuity payable on satisfactory completion of contract at rate of £37 10s. for each 3 months' service: £30-£60 Outfit allowance: Free Passages: Free medical and dental treatment: Generous home leave.

Candidates should have either (a) A University degree in civil engineering recognised by the Institution of Civil Engineers and two years subsequent experience or (b) Passed Parts I and II Finals of the Institution of Civil Engineers' examinations or an exempting diploma and had a total of five years' general experience on civil engineering works. Specialised experience is not necessary.

Further particulars on written application to DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, GREAT SMITH STREET, LONDON, S.W.1. Give brief details of age, qualifications and experience. Quote reference BCD/63/408/03/D5. K 346

Classified Advertisements continued on Page 6

KENT COUNTY COUNCIL.

require

SENIOR HEATING ENGINEERS with good experience in the design of installations for all types of buildings. Salary within scales £880 to £1080 and £710 to £885, according to ability and experience. Applicants must be Corporate Members of the Institution of Heating and Ventilating Engineers. Application forms from COUNTY ARCHITECT, SPRINGFIELD, MAIDSTONE. Closing date 1st March, 1956. K 345

RHODESIA RAILWAYS.

VACANCIES FOR DRAUGHTSMEN.

Vacancies exist for

CIRCUIT DRAUGHTSMEN, not less than 26 years of age, in the Signal and Telegraph Section of the Chief Engineer's Department of the Rhodesia Railways. It is essential that applicants should have served with the British Railways in a Signal and Telecommunications Department and/or in a Railway Signalling Manufacturing Company and should be experienced in the preparation of signalling circuit diagrams.

The salary range is £1053 (commencing) to £1271 (maximum) per annum. The vacancies are for appointment on the temporary staff in the first instance, but transfer to the permanent staff may be made to fill vacancies on the recommendation of the Chief Engineer. Liberal leave is granted and generous medical benefits are provided for which employees pay a monthly contribution and in addition, immediately on transfer to the permanent staff, an employee becomes a member of the Contributory Pensions Fund.

Applicants should apply to the LONDON AGENT, RHODESIA RAILWAYS, 241, SALISBURY HOUSE, LONDON WALL, LONDON, E.C.2, for further particulars. K 271

RHODESIA RAILWAYS.

VACANCIES FOR ASSISTANT SIGNAL AND TELEGRAPH ENGINEERS.

Vacancies exist for

ASSISTANT SIGNAL AND TELEGRAPH ENGINEERS for service in the Chief Engineer's Department of the Rhodesia Railways.

It is essential that applicants should have served with the British Railways in the Signal and Telegraph Communications Department and/or in a Railway Signalling Manufacturing Company for a period of not less than five years, and be a Student or an Associate Member of the Institution of Railway Signal Engineers or an Associate Member of the Institution of Electrical Engineers with signalling experience.

The salary scale is £850 per annum (commencing) up to £1800 (maximum) per annum. The commencing salary within the scale mentioned will depend on the age, experience and qualifications of the applicants. In addition to the salary quoted, a Children's Allowance of £48 per annum is payable for the first child and £24 per annum for each additional child, up to and including a salary of £1000 per annum. The allowance is reduced when an employee attains a salary of over £1000 per annum.

The vacancies are for appointment on the temporary staff in the first instance but transfer to the permanent staff will be made to fill vacancies on the recommendation of the Chief Engineer.

Housing is provided for married Engineers who are liable for transfer, at moderate rentals. Where no Railway housing is provided a Marriage Accommodation Allowance of £72 per annum is payable under certain conditions.

Liberal leave is granted and generous medical and hospital benefits are provided for which employees pay a monthly contribution and in addition immediately on transfer to the permanent staff, an employee becomes a member of the Contributory Pension Fund. Employees are required to contribute 5 per cent. of their monthly salary to the Contributory Pension Fund.

The Rhodesia Railways will bear the full fare from the point of embarkation to the port of disembarkation, subject to the Administration selecting the class and type of transport. In the case of a married man, the Railways will bear up to a maximum of £70 for his wife and a further total sum of £70 to cover his dependent children under the age of 18 years. In addition free third class travel will be provided for himself, wife and family from his home town to port of embarkation, and free first class travel from port of disembarkation to Bulawayo or the place of employment on the Rhodesia Railways.

Applicants should apply to the LONDON AGENT, RHODESIA RAILWAYS, 241, SALISBURY HOUSE, LONDON WALL, LONDON, E.C.2, for further particulars of Conditions of Service. K 272

SCOTTISH GAS BOARD—EDINBURGH DIVISION.

CHEMICAL AND ENGINEERING STAFF.

A number of vacancies exist in the Edinburgh Division of the Scottish Gas Board for

JUNIOR TECHNICAL STAFF to assist in the control of production and distribution processes.

Applicants must be of good general education and have attained, or be proceeding to, National Certificate standards in Chemistry or Engineering.

Salaries will be according to capabilities and experience.

The successful candidates will be required to pass a medical examination and will be subject to the provisions of the superannuation scheme of the Scottish Gas Board.

Applications, stating age, training, qualifications and experience should be made to the undersigned within fourteen days of the appearance of this advertisement.

DAVID BEAVIS,
DIVISIONAL CONTROLLER,
EDINBURGH DIVISION,
SCOTTISH GAS BOARD,
15, CALTON HILL,
EDINBURGH, 1. K 280

NEW SOUTH WALES GOVERNMENT.

Applications are invited for a post of

ELECTRICAL ENGINEER in the London Office of the Government of New South Wales. Candidates should be over 30 years of age, Corporate Members of the Institution of Electrical Engineers, or equivalent, and have good knowledge of transmission and distribution equipment, especially E.H.T. transformers. Experience in the testing of such plant and materials desirable. Duties involve general supervision of contracts and visits to works of contractors as required. Experience of similar work an advantage but not essential for this interesting post. Salary up to £1300 per annum according to qualifications and experience.—Applications (in writing only), giving full details in chronological order, should be addressed to the AGENT-GENERAL FOR NEW SOUTH WALES, 56, STRAND, LONDON, W.C.2, endorsed "Electrical Engineer." Original testimonials should not be included.

Replies will only be sent to candidates selected for interview. K 310

DESIGN ENGINEERS.

Vacancies exist with the Industrial Group of the UNITED KINGDOM ATOMIC ENERGY AUTHORITY AT RISLEY, NR. WARRINGTON.

DUTIES: To prepare schemes for alterations and additions to existing plants to improve their efficiency and to be responsible for the detail design and ordering and to follow up construction of approved schemes. Constant liaison with staff at the Authority's Works will be required.

QUALIFICATIONS AND EXPERIENCE: Applicants must have served a recognised engineering apprenticeship or have received equivalent training and be Corporate Members of a Senior Engineering Institution, or have equivalent qualifications and have considerable experience preferably in a production industry.

SALARY: £1130 rising by annual increments of approximately £35 to £1435 p.a.

Successful candidates if under 55 will be required to join the Authority's contributory pension scheme, which includes Widows' and Dependants' benefits.

Suitably qualified persons are invited to send a postcard quoting reference 1277 for form of application to RECRUITMENT OFFICER, U.K.A.E.A., I.G. H.Q., RISLEY, NR. WARRINGTON.

Closing date 17th February. K 297

ENGINEERS.

Vacancies exist with the UNITED KINGDOM ATOMIC ENERGY AUTHORITY IN THE SUPPLY BRANCH AT RISLEY, NR. WARRINGTON.

DUTIES.

(*a*) ESTIMATING AND SANCTIONS SECTION. Estimating costs of construction of large and complicated engineering projects, most of which are of a novel and unorthodox nature and subsequently exercising control over the approved expenditure.

(*b*) STANDARDS SECTION. Standardisation of all engineering materials and spares and recommending the level of stocks of such items to be held in the various stores, throughout the Industrial Group. Also the preparation of specifications for such standard items, to enable purchases to be carried out by non-technical staff of a normal stores control organisation.

(*c*) BUYING SPECIFICATIONS SECTION. Negotiating for the production, fabrication and installation of the various types of plant which may be required by the Industrial Group. Duties include the writing of specifications and technical contract conditions to govern the supply of this class of engineering equipment.

QUALIFICATIONS AND EXPERIENCE.

Candidates must have served a recognised engineering apprenticeship and be Corporate Members of the Institutions of Civil, Mechanical, Electrical or Chemical Engineers, or hold equivalent qualifications. They should have some experience of engineering markets, modern methods of fabrication and installation, and specialised experience in the work of one of the types stated above is essential. Candidates must be capable of discussing the Authority's requirements with the engineering industry.

SALARY.

£1130 rising by annual increments of approximately £35 to £1435 p.a.

Successful candidates, if under the age of 55 will be required to join the Authority's Contributory pension scheme, which includes Widows' and Dependants' benefits.

Suitably qualified persons are invited to send a postcard quoting reference 1268 for form of application to RECRUITMENT OFFICER, U.K.A.E.A., I.G. H.Q., RISLEY, NR. WARRINGTON.

Closing date 24th February, 1956. K 298

ASSISTANTS (SCIENTIFIC). The Civil Service Commissioners invite applications for pensionable posts.

Age at least 17½ and under 26 years of age on 1st January, 1956, with extension for regular service in H.M. Forces, but candidates over 26 with specialised experience may be admitted.

Candidates must produce evidence of having reached a prescribed standard of education, particularly in a science or mathematical subject. At least two years' experience in the duties of the class gained by service in a Government Department or other civilian scientific establishment or in technical branches of the Forces essential in one of the following groups of scientific subjects:—

(i) Engineering and physical sciences.
(ii) Chemistry, bio-chemistry and metallurgy.
(iii) Biological Sciences.
(iv) General (including geology, meteorology, general work ranging over two or more groups (i) to (iii) and highly-skilled work in laboratory crafts such as glass-blowing).

Inclusive salary scale, £280 (at 18) to £575 (men) or £502 (women). Starting pay up to £423 (men) or £385 (women) at 25. Women's pay subject to improvement under Equal Pay scheme. Somewhat less in provinces. Opportunities for promotion.

Further particulars from CIVIL SERVICE COMMISSION, SCIENTIFIC BRANCH, 30, OLD BURLINGTON STREET, LONDON, W.1, quoting No. 859/56. Completed applications should be returned, as soon as possible and in any case not later than 31st December, 1956. K 277

UNIVERSITY OF NOTTINGHAM.

DEPARTMENTS OF CIVIL AND MECHANICAL ENGINEERING.

Applications are invited for the following appointments:

LECTURER IN CIVIL ENGINEERING, salary scale £650 by £50 to £1050 by £50 to £1350 per annum; **SENIOR RESEARCH ASSISTANTS,** salary scale £650 by £50 to £1050 per annum. Superannuation and family allowances. Conditions of appointment and form of application from the undersigned, to whom applications should be sent by 25th February, 1956.

H. PICKBOURNE,
REGISTRAR. K 282

LANCASHIRE EDUCATION COMMITTEE.

WIDNES COMMITTEE FOR EDUCATION.

WIDNES COLLEGE OF FURTHER EDUCATION:

Applications invited for the following appointment **ASSISTANT GRADE "A"** in Engineering Department for Engineering Workshop subjects. Good workshop experience and at least a Final City and Guilds Certificate in Machine Shop Engineering or a Higher National Certificate in Mechanical Engineering required. Salary—Burnham Technical Scale with allowances and increments for approved industrial experience.

Application form obtainable from the BOROUGH EDUCATION OFFICER, LUGSDALE ROAD, WIDNES, to be returned as soon as possible. K 294

PHYSICISTS AND ELECTRICAL ENGINEERS required by MINISTRY OF SUPPLY AT FIGHTING VEHICLES RESEARCH AND DEVELOPMENT ESTABLISHMENT, NEAR CHERTSEY, SURREY, to study problems of crossing rough and soft ground by tracked and wheeled vehicles and to develop electronic recording techniques for evaluation of soil stresses and associated automotive problems. Appointments according to age, experience, etc., as SCIENTIFIC OFFICER (minimum age 21), or SENIOR SCIENTIFIC OFFICER (minimum age 26). Qualifications: 1st or 2nd class honours degree or equivalent in Physics or Electrical Engineering. At least three years post-graduate experience required for S.S.O. Salaries within ranges: S.O., £488 10s. to £885, or S.S.O., £1030 to £1,185 (superannuable).—Application forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting A489/5A/BG. K 273

WAR OFFICE require

PROFESSOR OF MANAGERIAL STUDIES at the R.E.M.E. OFFICERS' SCHOOL, ARBORFIELD, NEAR READING, appointment for 2 years in first instance. Inclusive salary, £1900 per annum. 30 days Annual Leave. Qualifications: Degree in Mechanical or Electrical Engineering and/or corporate membership of one or more of the Institutions of Mechanical, Electrical or Production Engineers. At least 20 years industrial experience (including experience as a management consultant or at least 3 years in position of executive responsibility). Previous instructional or lecturing experience is desirable but not essential.—Application forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting C 537/5A. K 274

CIVIL ENGINEERS IN GOVERNMENT DEPARTMENTS. The Civil Service Commissioners invite applications for pensionable posts.

Age: At least 25 and under 35 on 1st January, 1955, with extension for regular service in H.M. Forces and, up to two years, for permanent civil service. Candidates must be Corporate Members of the Institution of Civil Engineers or have passed or been exempted from Sections A and B (now Sections I and II).

London salary scale (men), £705 (at age 25) to £1095. (Somewhat lower in provinces.) Starting salary according to age up to £970 at 34. Prospects of promotion. Salaries of next higher grades are £1095-£1415 and £1470-£1595. Women's salaries lower but being improved under equal pay scheme.

Further particulars and application forms from CIVIL SERVICE COMMISSION, SCIENTIFIC BRANCH, 30, OLD BURLINGTON STREET, LONDON, W.1, quoting No. 864-66/55. Completed applications should be returned as soon as possible and in any case not later than 31st March, 1956. K 278

JIG AND TOOL ENGINEER.

A vacancy exists with the INDUSTRIAL GROUP OF THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY AT WINDSCALE WORKS, SELLAFIELD, CUMBERLAND.

DUTIES: To undertake operation planning and detailed development and design for a machine shop engaged on the production of graphite components. The successful candidate will have to carry out detailed drawing work.

QUALIFICATIONS AND EXPERIENCE: Candidates should have completed an engineering apprenticeship and have had considerable experience as a jig and tool draughtsman, preferably in a live production industry. Detailed design experience for at least three years is essential. They should be Members of the Institution of Mechanical Engineers and membership of the Institute of Production Engineers would be an advantage.

SALARY: £728 (at age 25), rising by annual increments of approximately £30 to £1130 p.a.

A house may be available within a reasonable time for the successful candidate, if married.

The successful candidate if under 55 will be required to join the Authority's contributory pension scheme, which includes Widows' and Dependents' benefits.

Suitably qualified persons are invited to send a postcard quoting reference 1273 to RECRUITMENT OFFICER, U.K.A.E.A., I.G. H.Q., RISLEY, NR. WARRINGTON. Closing date, 17th February, 1956. K 299

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY
(University of London.)

Applications are invited for the post of **LECTURER IN MINE MECHANICAL ENGINEERING,** salary depending on qualifications and experience within the range £700 to £1400 p.a. The post carries annual increments of £50 up to £1400, with an efficiency bar at £1000, family allowance and F.S.S.U. benefits.

Applicants should be honours graduates in engineering, preferably with mining experience; academic or research experience will be an advantage but is not essential.

Applications should reach the PROFESSOR OF MINING, ROYAL SCHOOL OF MINES, IMPERIAL COLLEGE, LONDON, S.W.7, before April 30th, and further particulars may be obtained from him. K 349

HER MAJESTY'S OVERSEA CIVIL SERVICE TANGANYIKA.

FACTORY INSPECTOR (men only and under 40) required to organise factory inspection, administer factory legislation and train and supervise other factory inspectors. Degree in engineering or professional equivalent (e.g. A.M.I.E.E.) with preferably experience in administration of factories legislation. Post permanent and pensionable. Salary scale, £816 to £1620 plus 10 per cent. non-pensionable cost-of-living allowance. Outfit allowance. Quarters provided if available at low rental. Free passages. Generous home leave. Low Income Tax. Further particulars and application forms obtainable from DIRECTOR OF RECRUITMENT (OVERSEA SERVICE), COLONIAL OFFICE, GREAT SMITH STREET, LONDON, S.W.1, quoting BCD.132/8/01. K 306

LONDON COUNTY COUNCIL.

POPLAR TECHNICAL COLLEGE, as soon as possible.

LECTURER TO TEACH MATHEMATICS to H.N.C. level and to be responsible for general supervision over the teaching of Mathematics in senior departments. Burnham F.E. salary scale, £965 by £25 to £1065.—Application forms from Secretary at College, Poplar High Street, E.14, returnable by 18th February (190). K 303

UNIVERSITY OF LONDON.—The Senate invite applications for the

CHAIR OF NUCLEAR POWER tenable at the Imperial College of Science and Technology (salary not less than £2100 a year). Applications (10 copies) must be received not later than 16th March, 1956, by the ACADEMIC REGISTRAR, UNIVERSITY OF LONDON, W.C.1, from whom further particulars may be obtained. K 343

UNIVERSITY OF LONDON.—The Senate invite applications for the

READERSHIP IN NUCLEAR POWER tenable at the Imperial College of Science and Technology (salary £1300—£1550—£1800 a year). Applications (10 copies) must be received not later than 16th March, 1956, by the ACADEMIC REGISTRAR, UNIVERSITY OF LONDON, W.C.1, from whom further particulars may be obtained. K 344

TUNNELLING ENGINEER required in Mining Operations Branch of N.C.B's Production Dept. in London, for co-ordinating and supervising a special project to develop the organisation of efficient high speed tunnel drivage, followed by the establishment of demonstration tunnels in different coalfields and training of tunnelling crews. Intimate experience of high speed tunnel driving with modern methods and machinery is required, preferably with a 1st Class Cert. of Competency or a degree in coal or metalliferous mining, though this is not essential. Appointment (superannuable), according to qualifications and experience, but not less than £1600 per annum.

Write, with full particulars of age, education, qualifications and experience to NATIONAL COAL BOARD, STAFF DEPT. (PERSONNEL), HOBART HOUSE, GROSVENOR PLACE, LONDON, MARKING ENVELOPE SS/196, before 16th March, 1956. K 338

EUROPEAN ORGANISATION FOR NUCLEAR RESEARCH, GENEVA, will have a number of vacancies during 1956, for

RESEARCH PHYSICISTS, ELECTRICAL, ELECTRONIC AND MECHANICAL ENGINEERS to assist in the design and construction of high energy accelerating machines and to carry out nuclear research. The posts in varying grades carry salaries ranging from 12,120 to 28,200 Swiss francs, tax free, per annum, plus allowances. First class qualifications and experience essential. For further information and application forms write to the SECRETARY, MINISTRY OF LABOUR AND NATIONAL SERVICE, ALMACK HOUSE, 26, KING STREET, LONDON, S.W.1, quoting A12/SW1/18/CERN. K 342

DUNDEE TECHNICAL COLLEGE.

MECHANICAL ENGINEERING DEPARTMENT.

Applications are invited for the post of **LECTURER GRADE II.** Salary Scales: Hons. Degree or equivalent—£696 by 30 to £990. Other Qualifications—£640 by £30 to £840. Placing will be given on the appropriate scale for approved industrial and/or teaching experience.

Forms of application, which may be obtained from the CLERK AND TREASURER, DUNDEE INSTITUTE OF ART AND TECHNOLOGY, 40, BELL STREET, DUNDEE, should be returned not later than 29th February, 1956. K 325

STAFFORDSHIRE EDUCATION COMMITTEE.

BILSTON COLLEGE OF FURTHER EDUCATION.

Applications are invited from suitably qualified men for the post of **ASSISTANT GRADE "B" TO TEACH ENGINEERING SUBJECTS,** chiefly Science, Mathematics and Drawing to National Certificate standard.

Salary will be in accordance with the Burnham (Technical) Scales for Assistants, Grade "B," viz., £525 by £25 to £820 together with allowances for degree and/or approved training.

Application form, returnable by 25th February, and further particulars may be obtained from the undersigned on receipt of a stamped addressed foolscap envelope.

J. H. P. OXSPRING,
DIRECTOR OF EDUCATION.

DEPARTMENT F.E.,
COUNTY EDUCATION OFFICE,
STAFFORD. K 320

MUNICIPAL TRAMWAY TRUST,
ADELAIDE, SOUTH AUSTRALIA.

(a) **ROLLING STOCK ENGINEER.**
(b) **WORKSHOP ENGINEER.**

Applications are invited for the above appointments:—

The **ROLLING STOCK ENGINEER'S** position covers administration and operation of Trust's Workshops and Servicing Depots which at present maintains approx. 175 tramcars, 150 fuel buses (mainly diesel), 90 trolley-buses, and service vehicles.

The **WORKSHOP ENGINEER** is answerable to the Rolling Stock Engineer for overhaul of public service vehicles and miscellaneous vehicles, together with maintenance of equipment. Successful applicants must possess a wide engineering experience in above fields more particularly diesel.

COMMENCING SALARIES:
(a) **ROLLING STOCK ENGINEER,** A£2000 per annum.
(b) **WORKSHOP ENGINEER,** A£1750 per annum.

Ages should not exceed 45 years for (a) and 40 years for (b).

Opportunity for advancement in the service for men qualified to accept increased responsibilities. Both positions superannuable, assisted migration for successful applicants and families, also housing accommodation guaranteed.

Apply for Application Forms, and further details, to:—

RANALD J. HARVEY & PARTNERS,
CONSULTING ENGINEERS,
34, VICTORIA STREET,
LONDON, S.W.1. K 335

SPECIALIST ENGINEERS required for two superannuable appointments in N.C.B.'s FUEL EFFICIENCY SERVICE based at Stanhope Bretby, Nr. Burton-on-Trent. Salary, according to qualifications and experience, within range £746-£1210.

ENGINEER with University degree or equivalent professional qualification, to take charge of team of test engineers. Wide experience required in operation and testing of steam plant including shell and watertube type boilers, and preferably some knowledge of power and heat costing with considerable experience in the control of staff. Duties involve spending some time away from the base. (REF. No. 88/193.)

ENGINEER with H.N.C. (Mech. Eng.) or equivalent, and extensive practical experience in operation and maintenance of shell and watertube type boilers and steam-using plant. Ability required to train plant operators and assist in raising standard of steam plant operation and maintenance. Duties involve periods of detachment from base. (REF. No. 88/194.)

Write, with full particulars of age, education, qualifications and experience to NATIONAL COAL BOARD, STAFF DEPT. (PERSONNEL), HOBART HOUSE, GROSVENOR PLACE, LONDON, MARKING ENVELOPE WITH RELEVANT REF. No. before 19th March, 1956. K 323

THE MILK MARKETING BOARD of England and Wales require a male

TECHNICAL ASSISTANT to their Engineer. Applicants should have (a) H.N.C. in mechanical engineering, (b) practical experience in food, process or chemical engineering manufacture or layout, (c) competent draughtsmanship. Age 25 to 30. Very attractive salary according to qualifications.—Applications in writing to the ESTABLISHMENT OFFICER, MILK MARKETING BOARD, THAMES DITTON, SURREY. K 324

CITY COUNCIL OF SINGAPORE.

ELECTRICITY DEPARTMENT.

Applications are invited for the appointment of an **INSTRUMENT ENGINEER** on Agreement for two periods each of 3 years' resident service.

Applicants must be Graduate Members of the I.E.E. or possess the Higher National Certificate (Electrical) or equivalent. They must also have experience in the calibration, servicing and repair of instruments and auto-combustion control gear used in modern Power station practice, have thorough knowledge of the principles of combustion and of fully automatic boiler control, and must be capable of supervising and training staff. Minimum age, 25 years.

The salary scale of the post is $820 a month rising by annual increments of $30 to $880 a month ($1 Malayan = 2s. 4d.). Expatriation and Variable Allowances are also payable. Total emoluments on the salary of $820 a month are $1115 a month (£1561 per annum) for a single man, $1205 a month (£1687 per annum) for a married man with no children, and $1273 a month (£1779 per annum) for a married man with one or more children. Partly furnished quarters provided, if available.

Free passages for officer appointed and family subject to certain limits. Paid Home leave after 3 years, and end of Contract. Contributory Provident Fund.

Further details from the Council's London Agents: MESSRS. ALLEN & WILLIAMS, 1, VICTORIA STREET, WESTMINSTER, LONDON, S.W.1. Closing date for full applications in DUPLICATE:—Tuesday, 28th February, 1956. K 337

CITY COUNCIL OF SINGAPORE.

ENGINEER'S DEPARTMENT.

Applications are invited for appointment of **ASSISTANT SEWERAGE ENGINEER** on Agreement for two periods each of 3 years' resident service.

Applicants must be Associate Members of the Institution of Civil Engineers with at least 10 years' suitable engineering experience (i.e., 10 years' suitable engineering experience since being elected an Associate Member, or 12 years' suitable engineering experience since passing Parts A and B of the Institution's examination or their equivalent, provided such experience is gained after the applicant's 23rd birthday), of which 5 years must have been of sewerage.

An applicant fulfilling the above conditions may receive an initial basic salary of up to $1235 per month in the salary scale $785 per month by annual increments of $45 to $1370 and a final increment of $50 to the maximum of $1420 per month $1 Malayan = 2s. 4d.). Expatriation and Variable Allowances are also payable. Total emoluments including current allowances on a basic salary of $1235 a month are $1606 a month (£2240 per annum) for a single man, $1690 a month (£2366 per annum) for a married man with no children, and $1830 a month (£2,562 per annum) for a married man with one or more children.

Partly furnished quarters provided, if available, at 12½ per cent. of basic salary. Free passages for officer appointed and family subject to certain limits. Home leave at the rate of 4 days per month of resident service on satisfactory completion of each 3-year period of resident service.

Officer appointed is required to become a member of the Municipal Provident Fund, and, if not offered appointment on the Permanent Establishment, will be given on satisfactory completion of the Agreement. Provident Fund benefits equivalent to 20 per cent. of basic salary drawn by him in respect of resident service during the period of the Agreement.

Further details from the Council's London Agents: MESSRS. ALLEN & WILLIAMS, 1, VICTORIA STREET, WESTMINSTER, LONDON, S.W.1. Closing date for full applications in DUPLICATE:—Thursday, 23rd February, 1956. K 336

APPOINTMENTS OPEN.

THE ENGAGEMENT OF PERSONS answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive or a woman aged 18-59 inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order 1952.

It is advisable when sending testimonials to forward copies and NOT originals.

JUNIOR DRAUGHTSMEN, having completed National Service, required for work on large chemical plant installations. A.E.S.D. minimum rates or above. Five-day week and superannuation scheme. —Apply by letter giving details of technical education to the CHIEF DRAUGHTSMAN, LAPORTE CHEMICALS LIMITED, CLIFTON HOUSE, EUSTON ROAD, LONDON, N.W.1. G 575

DRAUGHTSMEN with mechanical design experience are required for the Electronics Division of Saunders-Roe Limited. Applications are invited from suitably experienced men. Housing assistance, pension and assurance schemes and other amenities can be offered. Those interested should write quoting ref. E/65 and giving details of age, experience, etc. to the PERSONNEL OFFICER, SAUNDERS-ROE LIMITED, EAST COWES, ISLE OF WIGHT. K 188

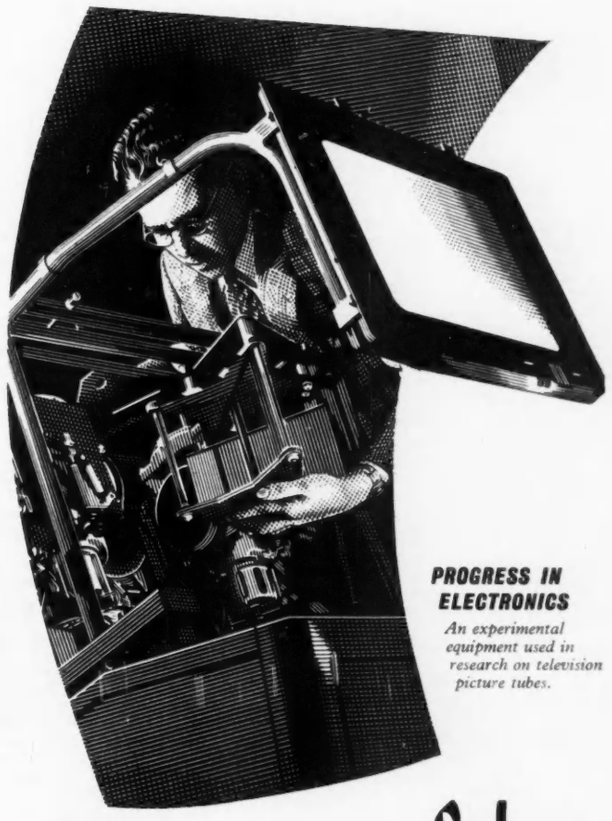
SALES ENGINEER. British Company require young man with good general knowledge of engineering to assist the Manager of the Department handling various mechanical and electrical engineering Agencies in Khartoum, Sudan. Excellent opportunity for keen and capable man. Accommodation available; free air passages; home leave; kit allowance; pension scheme.—Write BOX JA/125, c/o 95, BISHOPSGATE, E.C.2. K 114

SENIOR MECHANICAL ENGINEERING DRAUGHTSMEN required for interesting work on large chemical plant installations. Experience in this type of work is desirable but not essential, applicants with general mechanical engineering experience will be favourably considered. The posts offer excellent opportunities with generous salaries commensurate with experience and ability. Offices situated in the N.W.1 London area. Five-day week and superannuation scheme.—Applications, which will be treated in confidence, should give previous experience and qualifications and be addressed to the CHIEF DRAUGHTSMAN, LAPORTE CHEMICALS LIMITED, CLIFTON HOUSE, EUSTON ROAD, LONDON, N.W.1. G 576

ENGINEERING ASSISTANT required for Research Department. Applicants should have an engineering apprenticeship with O.N.C. or H.N.C. in Mechanical Engineering. Work will be in connection with the design development and laboratory testing of oil burning and spraying equipment for mass production. Permanent and pensionable position.—Apply, in confidence, giving full details of education, experience and salary required, to PERSONNEL MANAGER, MONITOR ENGINEERING AND OIL APPLIANCES, LTD., IRON LANE, STECHFORD, BIRMINGHAM, 33. K 259

MECHANICAL ENGINEER for medium and light engineering design. Experience of sheet metal fabrication batch production and special equipment an advantage.—Write giving full details to the PERSONNEL OFFICER, PHILIPS BALHAM WORKS, LTD., 45, NIGHTINGALE LANE, BALHAM, S.W.12. K 260

Classified Advertisements continued on Page 6



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An experimental equipment used in research on television picture tubes.

Peep into the future

Nowhere in the world is the technical quality of British television surpassed. And this leadership will be maintained, for, despite present-day achievements, research goes on ceaselessly.

In television, as in other fields of electronics, Mullard scientists work hand in hand with the designers of Britain's leading setmakers. This combination is your assurance of the highest available standards of performance and quality. When you buy a receiver fitted with a Mullard picture tube, Mullard valves and magnetic components, you are sure of the best possible return for your money.

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MP520E

MANAGER OF EXPERIMENTAL RESEARCH

RENOLD CHAINS LIMITED require an **ENGINEER** of outstanding ability to take charge of experimental investigations relating to the design and performance of the Company's products. The post is a new one demanded by expanding activity and requires initiative, ability to plan the work of the Department, flair for experimental work and for the design of related machinery. A good university degree in Engineering and experience in similar work is essential.

The appointment is to the Managerial Staff with good prospects for the right man. Consideration will be given to applicants up to age 52.

Please write fully to the EMPLOYMENT MANAGER, RENOLD CHAINS LIMITED, RENOLD HOUSE, WYTHENSHAWE, MANCHESTER, quoting Reference No. DE.2. K 285

DRAUGHTSMEN required at large expanding paper mills in Kent with experience of Civil Engineering and structural work. Must have H.N.C. in engineering or equivalent and be capable of working with minimum supervision. Good starting salary and prospects. Assistance with housing if required. Pension scheme.—Applications in writing giving age, experience and qualifications should be addressed to the PERSONNEL OFFICER, ALBERT E. REED & CO., LTD., AYLESFORD PAPER MILLS, LARKFIELD, NR. MAIDSTONE, KENT, quoting reference C.E.D.2. K 296

DESIGNER DRAUGHTSMEN required for interesting work involving design and development of mechanical handling devices and a variety of heavy plant. Experience main qualification. Substantial salary, good pension scheme and five-day week.—Write giving details of past experience and salary required to BOX K 286, Offices of ENGINEERING.

EXPERIENCED ELECTRICAL DESIGNER AND DRAUGHTSMAN required to H.N.C. standard or equivalent, preferably with some mechanical experience for development work on electrical application to Machine Tools. Five-day week, staff pensions scheme.—Write stating age and full experience to EMPLOYMENT OFFICE, ALFRED HERBERT, LTD., COVENTRY. K 321

YOUNG ENGINEER required as Estimator for London Sales Office of Gear Manufacturers. Must have Workshop and Drawing Office experience. Prospects of promotion to Sales Engineer. Detailed applications to BOX K 354, Offices of ENGINEERING.

METALLURGIST (QUALIFIED) required for light engineering works in West London for fundamental research work on the heat treatment of steel. Salary—up to £1000 per annum according to qualifications.—BOX K 339, Offices of ENGINEERING.

Advertiser requires
METALLURGIST (QUALIFIED) for light engineering works in West London for process control and development work. Salary—up to £1000 p.a. according to qualifications.—BOX K 340, Offices of ENGINEERING.

MECHANICAL ENGINEERING DRAUGHTSMAN required by A. GUINNESS, SON & CO. (DUBLIN), LIMITED, ST. JAMES'S GATE, DUBLIN, EIRE. Must be of good general education; age 25 to 27; H.N.C. or higher standard, and have had a sound practical apprenticeship in a modern engineering works.

At least a year's Drawing Office experience essential, preferably on beverage, food or chemical plant, pipe work, pumps, vessels, steam systems and supporting structures.

Must be able to pass stringent medical examination and be of active and energetic character.

Starting salary in range £600 to £700 p.a. Annual increments if satisfactory, and excellent prospects for a good man.

Reply to CHIEF ENGINEER stating age and qualifications, with chronological statement of education, apprenticeship and posts held. All expenses paid if selected to come for interview. K 261

ELECTRICAL ENGINEER required. H.N.C. minimum qualifications with at least three years experience in electronics. Permanent appointment with interesting possibilities, depending mainly on the individual.—Applications should be addressed to THE PERSONNEL OFFICER, PHILIPS BALHAM WORKS, LTD., 45, NIGHTINGALE LANE, S.W.12. G 639

A SENIOR MECHANICAL AND PLANT ENGINEER is required for work in London Consultants Office. The successful applicant will be responsible for work of the mechanical engineering design office and must possess first class qualifications. There is a Staff Pension Scheme.—Please reply in confidence to BOX NO. 384, GLOVERS ADVERTISING, LTD., 351, OXFORD STREET, W.1. G 642

SENIOR ELECTRICAL ENGINEER

required to form and take charge of an Electrical Test and Development Section at Brough. The required qualifications comprise at least H.N.C. or its equivalent and comprehensive experience on aircraft electrical systems and components.

Replies giving full particulars and quoting Reference: 23156 to:—
DESIGN SUPERINTENDENT,
BLACKBURN & GENERAL AIRCRAFT, LTD.,
BROUGH, E. YORKS. K 267

MECHANICAL ENGINEER to be responsible to Chief Engineer for the installation and maintenance of machinery, mechanical handling equipment, steam plant, etc. Familiar with preventive maintenance and control of staff of about fifty men. Commencing salary in the range of £750-£850.—Apply stating experience, qualifications and age to BOX K 257, Offices of ENGINEERING.

CHIEF ENGINEER FOR TURBINE TANKER

Wanted. Chief Engineer for new 25,000 tons d.w. Turbine Driven Tanker, now fitting out at Middlebrough. Good salary and conditions offered to a capable engineer, reply fully to:

Superintendent Engineer,
Stevinson, Hardy & Co. Limited,
155, Fenchurch Street,
London, E.C.3.
K 313

CHIEF ENGINEER
required by
substantial general Engineering Company
SLOUGH.

Responsibility design, development, product engineering.

Only first-class qualified men considered.

Salary £2000 plus.

Write in confidence, stating age and experience to MANAGING DIRECTOR, BOX E.G.648 c/o 191, GRESHAM HOUSE, E.C.2.
K 268

ENGINEER required for starting-up small-medium chemical plant. 25-35, single man preferred. H.Q. in London but applicants must be prepared to travel extensively. Minimum qualification O.N.C. or equivalent, the main essentials being intelligence, enthusiasm and mobility. Good salary and prospects for the right man, pension scheme.—Apply: THE BRITISH CECA CO., LTD., 175, PICCADILLY, W.1, in writing only. K 262

PRACTICAL DEVELOPMENT ENGINEER, AGED 28-40, required by progressive and well-established pipe manufacturer with modern works in London area, for interesting work on plastic pipe installation systems and fabrication technique. Excellent scope for suitable applicant. Knowledge languages useful, but not essential.—Write with full details, giving age, experience and salary required to BOX K 266, Offices of ENGINEERING.

have their new accommodation extension well under way and it should be available towards the middle of the year.

We shall then be looking for experienced men and women in the following categories:

A. ENGINEERING
Project Engineers

B. DESIGN ENGINEERING
Piping Designer/Draughtsmen
Structural (R.C.) Designer/Draughtsmen
Structural (Steel) Designer/Draughtsmen
Electrical Designer/Draughtsmen
Instrument (Electrical & Piping) Designer Draughtsmen

C. PURCHASING
Internal Expeditors **Field Expeditors**
Field Inspectors

If you want a permanent job in a good Company with a reputation second-to-none in the petroleum and chemical industries, why not write to us now? If you are suitable we will tell you whether we can employ you when we expand into the new accommodation.

We pay top salaries and in addition we offer:

* Generous sickness benefits
* Luncheon Vouchers
* A Pension and Life Insurance Scheme
* Social Club activities
* 5-day week
* Good overtime pay
* Excellent working conditions, etc., etc.

We will honour any holiday arrangements that you may make before joining us Write now to the Personnel Manager, DEPT.63/H

KELLOGG INTERNATIONAL CORPORATION
7-8, CHANDOS STREET, LONDON, W.1. K 301

STRUCTURAL ENGINEER required by London firm of Consultants to take charge of their steel design office. Candidates must have a comprehensive knowledge of all types of structural steelwork both designing and detailing and should preferably have had some works experience. Applicants should be Corporate Members of one of the senior professional Institutions or hold similar Degrees. The post is a permanent one and there is a Staff Pension Scheme.—Please reply in confidence to BOX NO. 389, GLOVERS ADVERTISING, LTD., 351, OXFORD STREET, W.1. G 643

GRADUATE MECHANICAL ENGINEER. An interesting opening for a graduate mechanical engineer has arisen in a rapidly expanding industrial Research Organisation. The work involved is concerned with all aspects of the development of new types of Diesel Engines, and a move is shortly to be made into a new Research Building which will allow considerable scope for the introduction of new equipment and techniques. The range of engines is extremely wide and modern equipment is in extensive use. Applicants should be between 28 and 35 years of age and preference will be given to those with previous experience in this or allied fields. Post pensionable. Applications giving particulars of training and experience to BOX K 276, Offices of ENGINEERING.

ENGINEER OR CHEMICAL ENGINEER required aged about 25 to 30 years with a degree (honours preferred) to train by practical work for a special position in connection with one of the Company's products. This will bring him in close contact with the most interesting and up-to-date methods in applied scientific technology, amongst others, those involving new metals, plastics, etc., with an advanced chemical background. Latent ingenuity will be encouraged. Whilst good education and a university background is looked for, more value will be placed on tact and personality in the prospective candidate. Industrial experience will be an advantage.

Pension Fund, Social and Sports Club, Canteen facilities, Annual holiday with pay.

Applications to be addressed to the CHIEF CHEMICAL ENGINEER, LAPORTE INDUSTRIES LIMITED, HANOVER HOUSE, 14, HANOVER SQUARE, LONDON, W.1. K 275

THE IRON AND STEEL INSTITUTE requires **ASSISTANT (AGE ABOUT 30-40 YEARS)** to supervise preparation of and to edit abstracts. Knowledge of manufacture and properties of iron and steel necessary, foreign languages useful. Five-day week. Write, stating age, experience and salary required to SECRETARY, THE IRON AND STEEL INSTITUTE, 4, GROSVENOR GARDENS, LONDON, S.W.1. K 283

DRAUGHTSMEN AND STRESSMEN. Vacancies exist for senior and intermediate design Draughtsmen and Stressmen with sound aeronautical or mechanical engineering experience to join progressive and rapidly expanding organisation. Applicants must have completed National Service and have high degree of enterprise and initiative. Good salaries will be paid in accordance with ability and experience.—Write to CHIEF DRAUGHTSMAN (D. & S.), MICROCELL LTD., 56, KINGSWAY, W.C.2. K 281

B.P. UNIVERSITY APPRENTICESHIPS.

British Petroleum Company, through their University Apprenticeship Scheme offer exceptional opportunities to young men who wish to become Technologists.

Degree courses can be taken at various British Universities in Chemistry, Physics, Electronic Engineering, Mechanical Engineering and Chemical Engineering. University educational costs and certain other expenses will be paid by the Company in addition to a commencing salary of £350 per annum. Apprentices will be Company employees and work in Company centres during long vacations to gain practical experience.

Applications may be made at any time during the final year at school, or during or immediately after National Service. Recruitment will normally be immediately after National Service, at any time during the year.

Candidates should not be over 22 years of age and should have University entrance qualifications which should include G.C.E. at "A" level in Mathematics, Physics, and Chemistry, and "O" level in English and one other language.

Applications, giving full particulars of age and qualifications should be addressed to BOX 8600, c/o 191, GRESHAM HOUSE, E.C.2.

K 284

THE AERODYNAMICS DEPARTMENT OF ARMSTRONG SIDDELEY MOTORS has vacancies for both
SENIOR AND JUNIOR DEVELOPMENT ENGINEERS for work on axial flow compressors, turbines and general airflow. A Degree in Mechanical Engineering and previous experience in this type of work an advantage. Initial salaries range from £650 to £1050 per annum, dependent on age, experience and qualifications but superscale rates would apply to senior experienced men. Excellent prospects and good pension fund.—Applicants should give full details quoting Reference Airflow 2, to TECHNICAL PERSONNEL MANAGER, ARMSTRONG SIDDELEY MOTORS, COVENTRY. G 625

EXECUTIVE ENGINEER
required by
BRANDT & O'DELL,
CONSULTING ENGINEERS,
GROSVENOR GARDENS HOUSE,
VICTORIA, S.W.1.

Applicants to be not less than 35 years of age, Surveying, and Building in general. Capable of controlling and managing Field Teams and Drawing Offices. Excellent remuneration. Apply in writing in first instance giving full particulars and salary required. G 626

Leading manufacturers of container closures in the Midlands have a number of vacancies for ambitious DESIGN DRAUGHTSMEN preferably with some experience in this or a similar sphere. Interesting work with excellent salary and every opportunity for promotion to senior position in a rapidly growing organisation. Write in confidence with details of experience, positions held, salary required; to P. A. METAL CLOSURES LIMITED, BROMFORD LANE, WEST BROMWICH. G 627

ARMSTRONG SIDDELEY MOTORS has vacancies in their
GAS TURBINE DEVELOPMENT STAFF FOR WORK ON SAPPHIRE AND VIPER ENGINES. Applicants must have a University Degree. Previous experience although desirable, is not essential. Initial salaries in the range of £600-£1000 per annum, dependant on age, experience and qualifications. Due to heavy forthcoming commitments and consequent expansion of departments, prospects for men of the right calibre are unusually good.—Applications with full details to Reference EXP/SV, TECHNICAL PERSONNEL MANAGER, ARMSTRONG SIDDELEY MOTORS, COVENTRY. G 628

CHIEF DRAUGHTSMAN required. Should have experience in the Radio or Electronics Industries with first class technical qualifications. Apply—A. B. METAL PRODUCTS LIMITED, ABERCYNON, GLAMORGAN, SOUTH WALES. K 269

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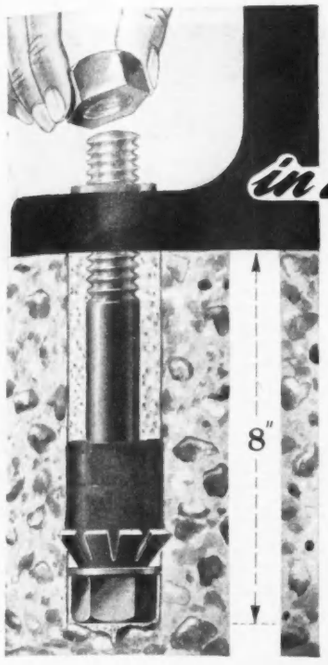

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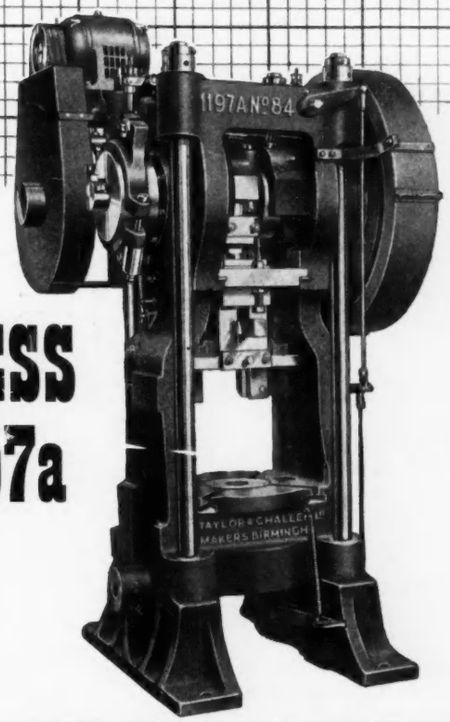

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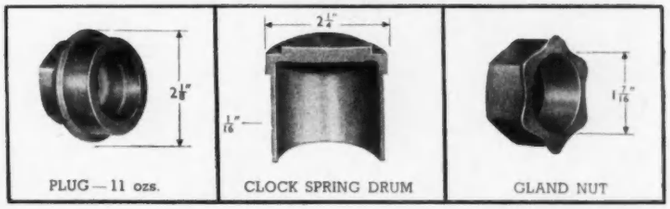

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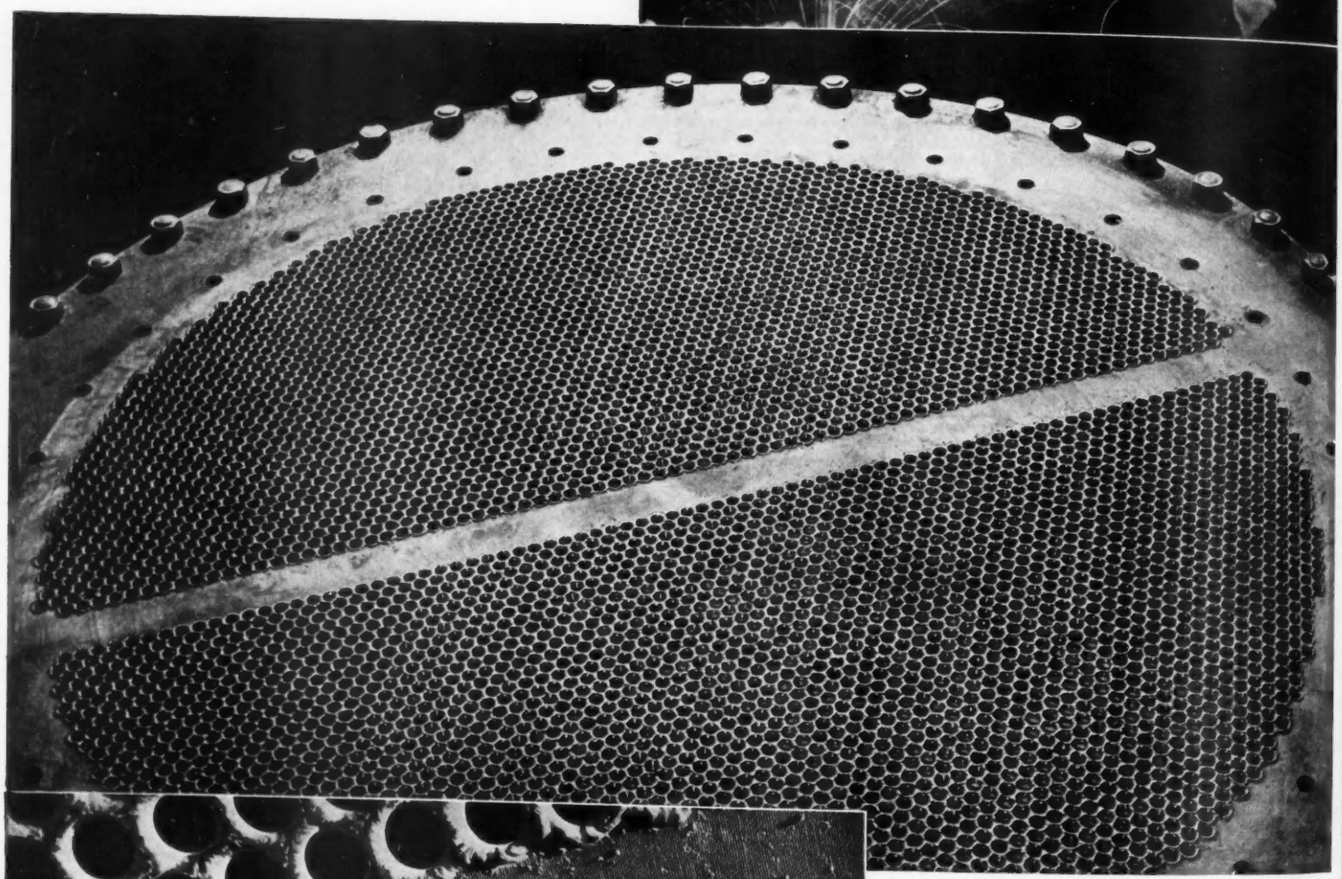

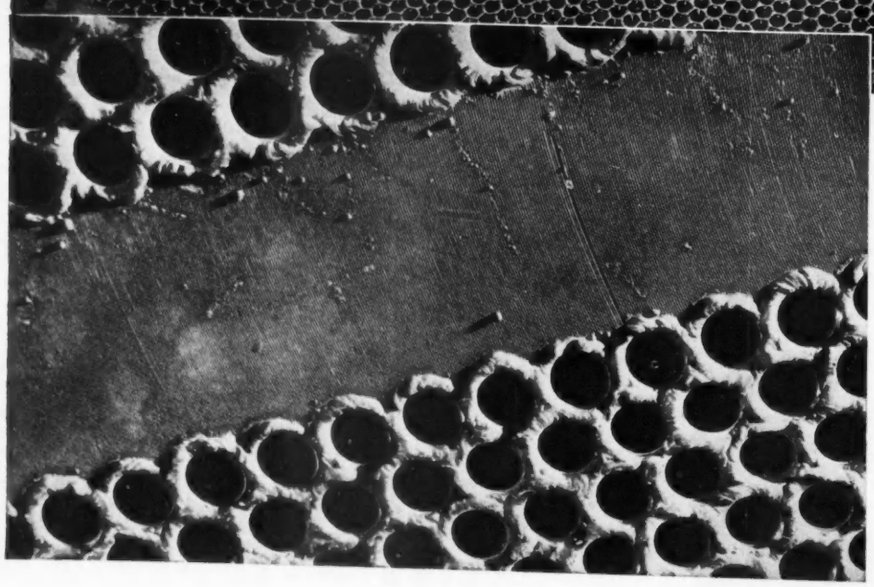

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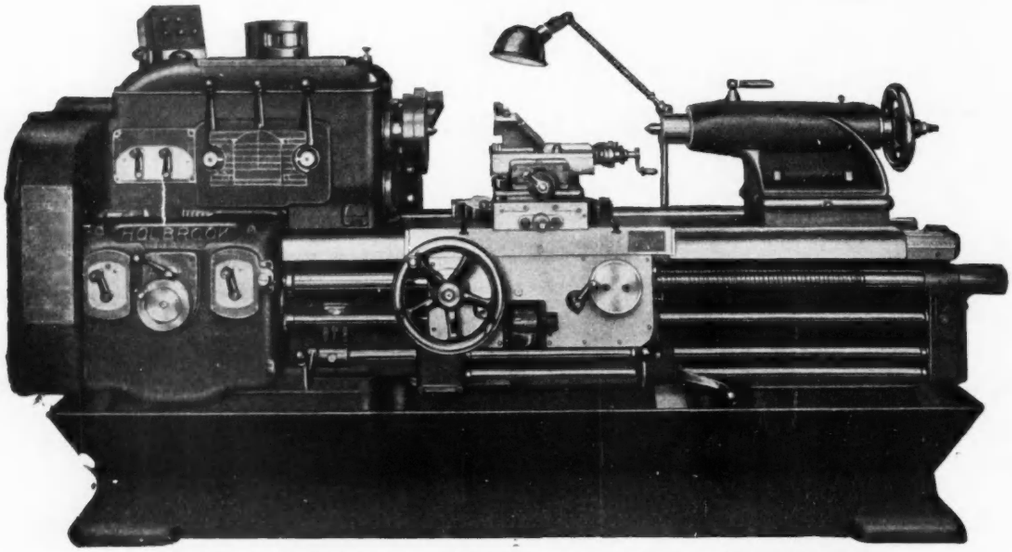

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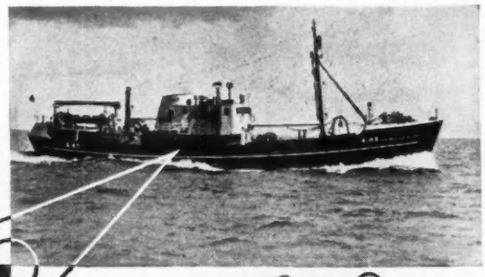

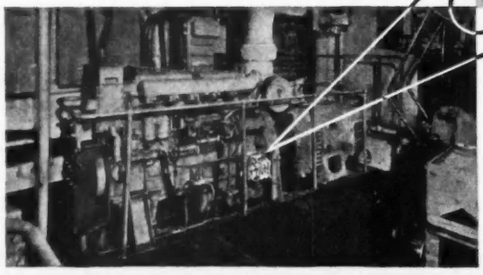

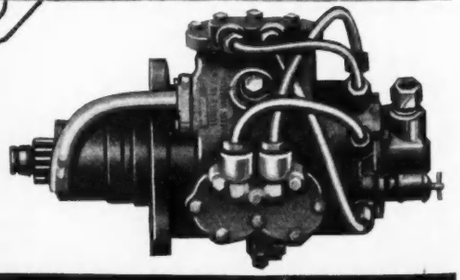

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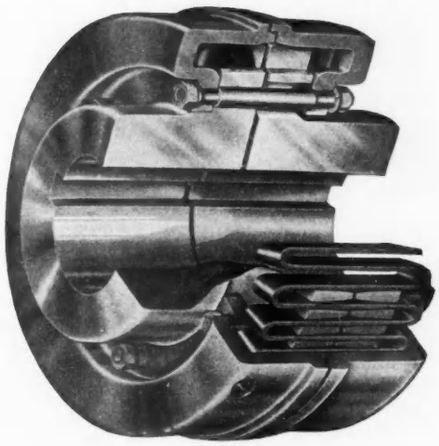

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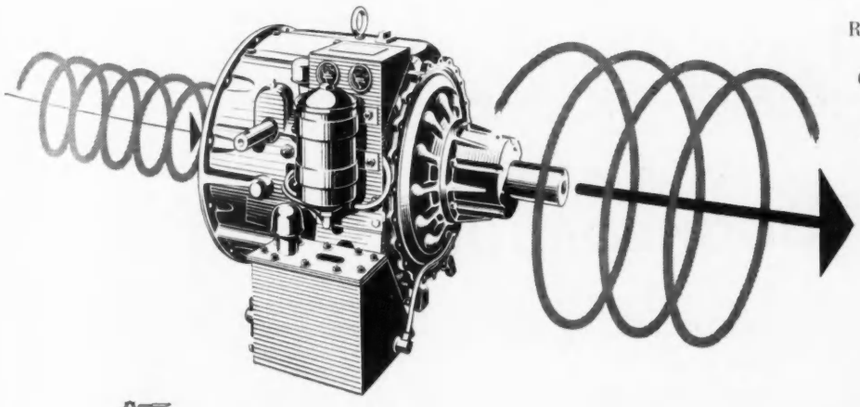

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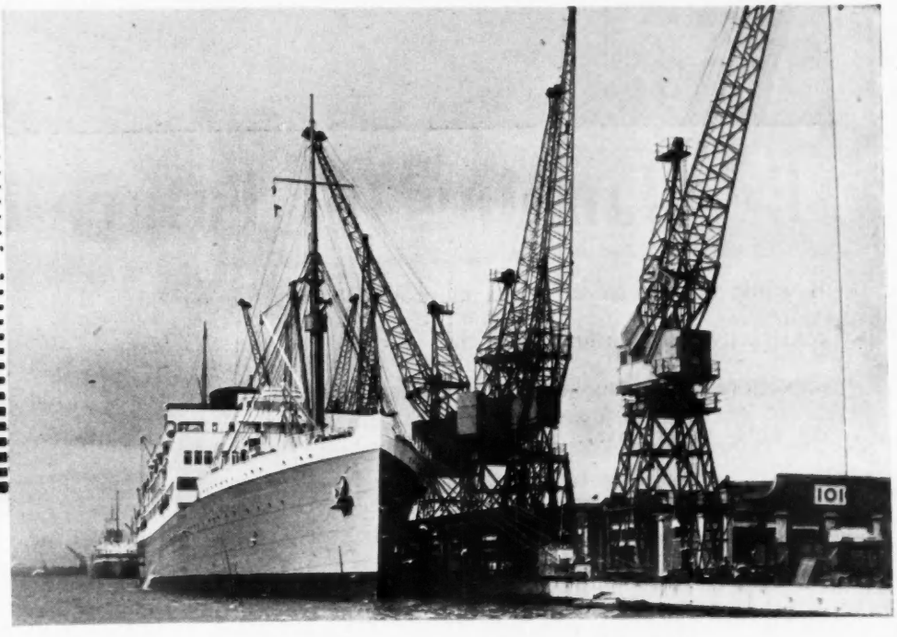

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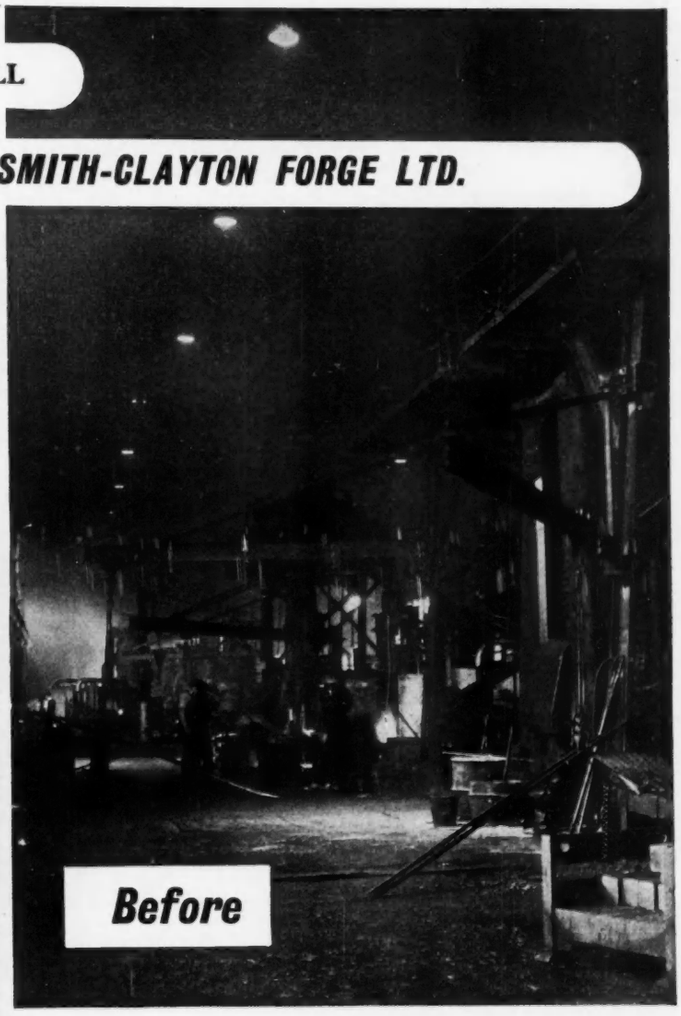

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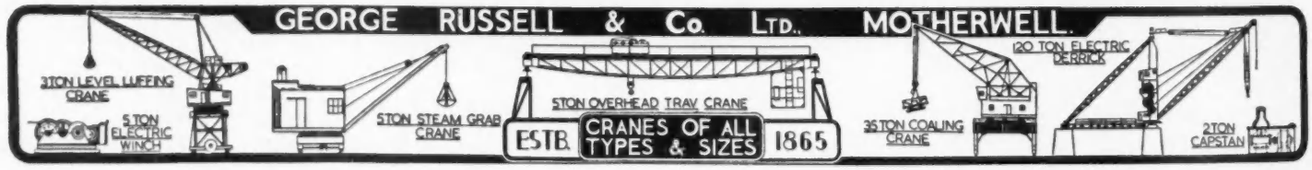
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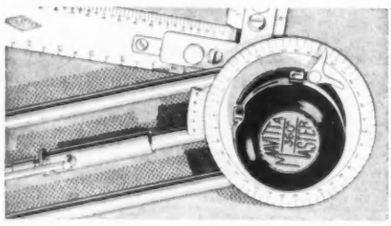

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ENGINEERING

An Illustrated Weekly Journal

Vol. 181 No. 4698 FEBRUARY 10, 1956

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INDEX TO "ENGINEERING"

Front Cover Photographs Preserved

The photographs used on the front covers of ENGINEERING have aroused considerable interest since they were introduced some years ago. In order to ensure that they are not lost when a volume of editorial pages is bound, the six-monthly index is now printed with the front-cover photographs on alternate pages. The first new-style index, for Volume 179, January to June, 1955, is now available without charge from the Publishers, ENGINEERING, 35 and 36 Bedford-street, Strand, London, W.C.2. Readers already on the index mailing list need not re-apply.

A MILD SHOCK?

THE committee appointed by the Minister of Fuel and Power 18 months ago under the chairmanship of Sir Edwin Herbert, to inquire into the "organisation and efficiency of the electricity supply industry in England and Wales," has produced a lengthy report which has been described by Lord Citrine as challenging and stimulating.

After expressing admiration for the zeal and devotion which have been shown at all levels since vesting day, it dilutes this glowing tribute by making a number of suggestions for future improvement. Of these undoubtedly the most important is based on the opinion that the full-time members and chief officers of the Central Electricity Authority are so burdened with day-to-day tasks that they have insufficient time to consider questions of high policy and development. Further, although the business of the Authority is nominally conducted by committees, it is in practice mainly in the hands of the chairman and deputy chairmen, assisted by the principal officers. An additional weakness is that certain chairmen of the Area Boards serve as part-time members of the Authority and may therefore be faced with the dilemma of divided allegiance.

It is therefore suggested that the Central Authority should be relieved both of the executive responsibility for generation and transmission and of the present vague responsibility for the industry as a whole. Its main duty, as re-constituted, would be to keep the industry "on its toes" and critically to review policies, programmes and expenditure. The construction and operation of power stations and of the transmission system would be transferred to a new statutory corporation—the Central Electricity Generation Board—the members of which, like those of the Area Boards, would not take part in the activities of the Central Electricity Authority.

Such a change would, it is considered, overcome the delays engendered by the present organisation of power station construction. It would also remove the irritation caused by the existing procedure to the divisional controllers, many of whom are men of wide experience. Devolution would be carried still further if the recommendation were adopted that no duties should be assumed by headquarters unless they could not be performed better locally. In fact, maximum power would be delegated to the divisional controllers and a step taken, as we have always considered it should be, towards greater de-centralisation.

On the other hand, the suggestion, so dear to the heart of some area chairmen, that Divisions and Boards should be amalgamated is not approved. In fact, it is considered that, with a few reservations of no great importance, the present separation of generation and distribution should be maintained. There can be no doubt that this is a correct decision. To do otherwise would re-impose upon the industry machinery similar to that in the 1926 Act which, although it worked, certainly did not do so without friction.

A recommendation which is likely to cause some controversy is that foreign manufacturers should be invited to tender for plant, if that would induce keener trading by British firms. With the report of the Monopolies Commission imminent this is a matter upon which comment had better be deferred. The need for more research is stressed, since the Boards should not be so dependent, as they are at present, upon the manufacturers for technical progress.

A number of other important questions are discussed in the report to which only passing reference can be made. One of these is that the number of entrants into the industry is smaller than it should be. Another is why men with the calibre of potential leaders are turning away from the industry. One reason is, of course, that instead of 540 undertakings, there is now only one, so that the number of "chief" posts is limited. At the other end of the scale, too, there has been a reluctance to adopt a policy of selective training and posting, probably in order to avoid charges of favouritism.

In the last analysis it is the human element which dominates the industry—as it does other industries. Seek that first and set it right, and all the other factors will be properly balanced. At the present time it is clear from the report that cases of redundancy are not being handled expeditiously. Too many men have too little to do. That is a situation which should be ended as soon as possible, so that private firms and other nationalised bodies can have the men they urgently need. The effect of the Herbert Report on the C.E.A. may give all the appearance of a mild shock, but in the national interest the Authority would be wiser to regard it as a case of severe shock.

★ ★ ★

We offer our apologies to readers, contributors and advertisers for the reduced size of this issue. It is caused by the current dispute in the printing industry—a dispute to which we are not a party. At the time of going to press it was not known when the dispute would end. We regret that it is not possible to say whether next week's issue will appear, but we hope that we and other publishers of periodicals will soon be allowed to resume normal publication.

Weekly Survey

Cover Picture: *The man on the shop floor is often heard to complain that the drawing office is out of touch with practical problems; inaccessible bolt holes lead only to exasperation, and ideal components that cannot be made serve no useful purpose. Faults of this kind are avoided by closer contact between draughtsman and craftsman. The illustration shows a shop-floor discussion on an item of sound-ranging apparatus.*

★ ★ ★

Up or Down?

Until the new Board of Trade capital spending forecast was published for the first time last week (it is dealt with in the next note) the only indication which the engineering industry had of the likely demand for its products was the monthly statistics of new orders for metal-working machine tools and the factory building applications published quarterly. The latest figures for both these rough and ready indices of the outlook of the engineering industry present rather an enigmatic picture.

New orders for machine tools in October increased slightly to £7·33 million compared with £6·94 million in September. Corresponding figures for total deliveries were £6·14 million and £6·77 million. The slight upward movement of new orders after a dip in September has to be contrasted with the drop in new factory space applications in the last quarter of 1955. At 17 million sq. ft. in the fourth quarter of the year, these applications were noticeably lower than in any of the three previous quarters or in the fourth quarter of 1954. There is some sign here of a slackening in estimates of requirements of future factory space, but whether this is a result of the credit squeeze or merely a coincidence will not be apparent until figures for several more quarters are available.

★ ★ ★

Forecast of Equipment Purchases

This year will be busy for the engineering industry, despite all the talk about the credit squeeze, if it develops in accordance with the figures published last week by the Board of Trade's new forecast of capital expenditure by private industry. This inquiry was discussed in Weekly Survey some time ago when the forms were sent out; the Board of Trade say the response has been extremely good. About 650 companies over a wide range of industry have sent in replies.

The questionnaire asked for actual capital expenditure in 1954, estimated expenditure in 1955, actual expenditure for the first three-quarters of 1955, and a forecast for 1956. Broadly, the answers which have been returned under these headings can be summarised as follows. Manufacturing industry expects to increase its capital expenditure by 17 per cent. in 1956. Capital spending last year is estimated to have risen by 18 per cent. on 1954, following five years when the total increase was only 10 per cent. and all of it accounted for by higher prices. Investment in building work is expected to go up in 1956 by 27 per cent. against an estimated increase of 34 per cent. last year. Outlay on plant, machinery and vehicles is put at 15 per cent. higher in 1956 than in 1955, and last year the increase over 1954 was 14 per cent.

Future questionnaires will ask for capital expenditure for each quarter in the autumn of each year and also for a forecast of expenditure during the following year. Once these returns have been running for some time they should provide a most useful tool for board and top management policy in the engineering industry.

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Confident Steelmakers

Hopes and plans for the future are discussed in the annual reports of two major steel companies published recently. Sir Walter Benton Jones, chairman of the United Steel Companies, Limited, outlined three important new schemes started or approved during the year under review. At Steel, Peech and Tozer, the £8·4 million medium-width strip mill is under construction, while further expansion of the electrical furnaces at the stainless steel works of Samuel Fox and Company, Limited, will cost an estimated £2·8 million. The cost of replacing the plate mill at the Appleby-Frodingham Steel Company is put at £3·2 million. United Steel are a highly diversified group, and are confident that the expansion and modernisation now taking place will be fully justified by rising demand.

Claims that John Summers and Sons, Limited, are also well diversified were put forward by Mr. Richard F. Summers, the chairman, in his annual statement. While the motor-car industry is a large user of sheet steel, Mr. Summers said that " on the industrial side perhaps the largest increase in demand for steel sheet and strip has been brought about by the greatly increased production and consumption of oil." Work has already begun on the £16·5 million project to expand capacity by over 20 per cent. within the next three years. Trading profit of the company rose by over 60 per cent. to nearly £8·7 million in the year ended October 1, 1955, and such an increase is considered essential if further development is to be financed from internal resources.

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Slow Denationalisation

The Iron and Steel Holding and Realisation Agency has still to dispose of 43 out of the 71 companies which it was directed to sell back to private ownership when steel was denationalised in 1953. The Agency's second annual report, published last week, covers the period from October 1, 1954, to September 30, 1955. It shows that in the first two financial years of the Agency's activities, 28 companies were sold back to private ownership, representing about three-fifths of the book value of the Agency's inheritance. In all, £152·1 million was realised by these sales.

Of the steel subsidiaries of the Agency still remaining for disposal, the Steel Company of Wales, Limited, and Richard Thomas and Baldwins, Limited, are the largest. These two companies between them have a book value estimated at around £126 million—approximately 57 per cent. of the total book value of all the remaining subsidiaries.

It may yet be some time before denationalisation is complete. While boom conditions in the first half of 1955 were conducive to disposal operations, the report indicates that credit restrictions, coupled with uncertainty engendered by strikes in the middle of 1955, had their effects in the second half of the year, and may well affect disposals in 1956.

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Future for Foundries

Recent reports from the Midlands indicate that the cutbacks in motor-car production are having some slight repercussions on manufacturers of castings. So far the foundries are not worried. Some car manufacturers have asked for extended delivery of certain components, while demand from other sources appears unabated. The expansion in steel, power-plant production and machine tool output is still bringing in a steady flow of orders for castings, and the only factor which at present gives concern is the continued shortage of labour. If adequate labour supplies were available, the foundries claim that more could be produced for export.

Even allowing for plentiful labour, however, foundries are still finding that tonnage of low and medium phosphoric ores are not yet sufficient to meet demand, while hematite pig-iron is still in short supply. Light foundries are rather more fortunate as supplies of high phosphoric iron are plentiful. The recent sharp fall in sales of domestic appliances appears to be having a marked effect upon their order books, however, and many firms are reported to be short of work.

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New Zeal for British Railways

A more effective use of material, plant, equipment and manpower can be achieved, in the opinion of the British Railways Productivity Council, by what it calls " planned productivity." This amounts, in fact, to a declaration of faith in the potentialities of modern work study methods. Since the council consists of representatives from the unions as well as from management, there is agreement on this issue on both sides of the industry. The use of outside consultants for work study is already going forward in some departments, so there is hope now that more than lip service will be paid to the idea.

Engineers will welcome this recent statement. If productivity can be raised it will ease the frustration among those salaried railway employees who feel they administer a machine where the least productive unskilled levels get the largest earnings increments. It will speed the day, too, when the railways can attract more engineers whose experience will contribute new ideas.

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Whither Transport?

Recent announcements on transport make one believe that the Ministry of Transport will succeed in bringing the country to a standstill within the foreseeable future.

In the House of Commons the new Minister of Transport has announced that inland waterway interests have been saddled with yet another committee of inquiry, though representations and evidence on the canals have been produced regularly for the last 100 years.

About four years ago the Road Research Laboratory condemned blinking traffic indicators even before the motor industry began to fit them on cars. Now that road users have been confused and irritated beyond endurance and the road accident rate has risen to unsurpassed heights the Minister has asked the laboratory to repeat their experiments, though there is little chance that their recommendations can differ from those originally given.

Last week saw the end of the first year of the Government's present road programme. The progress made during the year was summed up by Mr. Wilfred Andrews, chairman of the Roads Campaign Council as " 4·48 miles of new trunk road, equivalent to 7,884⅛ yards of red tape, or 567,705½ snail's paces."

Last week also saw the commencement of work by London Transport on a new air-terminal for helicopters. Meanwhile a Ministry of Transport committee have chosen this moment to put forward yet another proposal for a railway connection to London Airport. Such projects have been announced at roughly six-monthly intervals since London Airport was mooted. The helicopter station looks like being completed just in time for passengers to be able to foresee travelling directly by rail to Victoria.

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A Survey of Engineers

In spite of the shortage of engineers and other technologists it is almost impossible to obtain statistical data on the distribution of their employment in industry, Government service, etc., in the United Kingdom. Discussion and planning are thus conducted on a basis of vague generalities.

The deficiency will soon be overcome, however, as the Technical and Scientific Register of the Ministry of Labour are inquiring into the number of scientists and engineers in each main category, their distribution broadly between research and development, production and other duties, and the trend of demand over the next three years. Published results are expected later this year.

NAVAL FIGHTER WITH "BROWN" FLAPS

First Flight of Vickers-Supermarine N.113

Vickers-Armstrongs (Aircraft) Limited, Hursley Park, announce that a new naval carrier-borne fighter, the Vickers-Supermarine N.113, has made a successful first flight. A substantial production order has been placed for the Royal Navy. Powered by two Rolls-Royce Avon turbojets, it has been developed from Type 525, the main difference in external appearance being that it has a "tooth" wing leading edge and an all-moving tail. The N.113, illustrated herewith, is fitted with high lift flaps incorporating "supercirculation": air ducted from the engine compressor is blown over the upper surface of the flaps, thus increasing the lift by locally accelerating the airflow. This provides a considerable reduction in the deck-landing approach speed.

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ADMIRALTY TECHNICAL STAFF

New Apprenticeship Scheme

Previously to the recent war, the Admiralty was able to obtain the majority of the draughtsmen and subordinate technical officers required by the Royal Dockyards and other naval establishments through a craft-apprentice scheme, for which suitable boys were recruited on the basis of annual competitive examinations. Boys capable of being trained as naval architects and electrical engineers were also found by this means.

During the past ten years or so it has been found that the professional and technical officers required can no longer be obtained in this way. The Admiralty has decided, therefore, to supplement its craft-apprentice scheme by the recruitment of student apprentices, who will be selected and trained specifically to meet its needs for draughtsmen and subordinate technical officers. It is anticipated that a proportion of the boys selected for these apprenticeships will eventually be found suitable for further training as professional officers. Student apprentices will be recruited through open competitions conducted once a year by the Civil Service Commission. Candidates, who must be between 16 and 18 years of age, will be given a written examination in English, mathematics, physics and chemistry, and boys who reach a satisfactory standard will then be chosen for interview.

Student apprentices will receive five years' training at one of the four main dockyards (Chatham, Devonport, Portsmouth and Rosyth) in the basic principles underlying the building and repair of H.M. ships, followed by detailed training in either naval construction, marine engineering or electrical engineering. Although some training in the use of tools will be provided, it is not the intention to turn out highly-skilled craftsmen. Provided that they reach a sufficiently high standard, a few students will be selected at the conclusion of the fourth year of their courses for advanced training, with a view to their entry into the Royal Corps of Naval Constructors, and the other students, on the satisfactory completion of their five years' apprenticeships, will be appointed draughtsmen. The rates of pay for student apprentices will range from £2 18s. 11d. a week on entry to £6 11s. 1d. a week in the fifth year and there will be certain allowances in some cases.

The Admiralty will continue to recruit craft apprentices from among boys aged 15 to 17 years and, on the basis of their progress during the first year of their training, such apprentices will be eligible for transfer to student apprenticeships, when their training and prospects will be the same as those of direct-entry students. Copies of the regulations for the forthcoming student apprentices' examination, in April next, may be obtained from the secretary, Civil Service Commission, Burlington-gardens, London, W.1.

Obituary

SIR H. HOULDSWORTH, BT.

We regret to record the death of Sir Hubert Houldsworth, which occurred in London on February 1 at the age of 66. He had been connected with mining interests for most of his life and was chairman of the National Coal Board from 1951, a position from which he was about to retire.

Hubert Stanley Houldsworth was born at Heckmondwike, Yorkshire, on April 20, 1889, and educated at Leeds University where he obtained first-class honours in physics. After acting for some time as lecturer in the University he was called to the Bar and began his long connection with the mining industry. In 1936 he became independent chairman of the co-ordinating committee of the Midland Amalgamated District and was also appointed joint Coal Supplies Officer for the Midland Area of the Mines Department. He was then successively Fuel and Power Controller of the North Eastern Region and Regional Controller for South and West Yorkshire, until in 1943 he became Controller-General at the Ministry. Three years later he was appointed chairman of the East Midlands Division of the National Coal Board and was promoted to be chairman of the National Coal Board in 1951.

Houldsworth received the honour of knighthood in 1944 and was made a baronet in the recent New Years Honours List. He was Pro-Chancellor of Leeds University and for some years was Recorder of Doncaster.

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We regret also to record the deaths of:

MR. HAROLD ARNOLD TIPPETTS, at his home at Solihull, Warwickshire, on January 25, at the age of 67. He was chairman and joint managing director of L. H. Newton & Co. Ltd., Nechells, Birmingham, and was also chairman of two subsidiary companies, Birwelco Ltd., and Brown Fintube (G.B.) Ltd.

MR. HARRY ALLCOCK, M.I.Mech.E., M.I.E.E., at his home at Hale, Cheshire, on January 21, at the age of 76. Mr. Allcock was for many years export manager to W. T. Glover & Co. Ltd., Trafford Park, Manchester.

MR. ERIC CHRISTOPHER STANLEY MEGAW, M.B.E., in London on January 25, at the age of 48. He was educated at Queen's University, Belfast, and later joined the staff of the Research Department of the General Electric Company where he investigated methods of generating very short radio waves. Subsequently, he was responsible with others for the invention of resonator-stabilised and pulse magnetrons, the latter being used in 10cm. radar sets on both sides of the Atlantic. In 1946 he was appointed Superintending Scientist of the Radar Branch of the Admiralty Signal Establishment and later Director of Physical Research. He had served as chairman of the Radio Section of the I.E.E.

MR. DAVID NEVILLE TURNER, M.I.Min.E., on January 27, at the age of 82. He was a former chairman of the Staveley Coal and Iron Co. Ltd., and the Staveley Iron and Chemical Co. Ltd. Mr. Turner joined the Staveley Co. in 1920, was made managing director in 1926 and was elected chairman in 1941. He retired on July 1, 1951.

MR. ROBERT WILLIAM LESLIE HARRIS, B.Sc. (Durham), M.I.C.E., at his home at Thames Ditton, Surrey, on January 27, at the age of 47. Mr. Harris joined the staff of Preece, Cardew and Rider, consulting engineers, 8-12 Queen Anne's-gate, London, S.W.1, in 1950 and became a partner in April, 1953.

MR. GEORGE EDWARD ALLIN, at Stroud, Gloucestershire, at the age of 77. He was a past President of the Derby Society of Engineers. After an association with Ley's Malleable Castings Co. Ltd. lasting for 29 years, Mr. Allin joined Qualcast Ltd. as works manager in 1931. Subsequently he became general manager of Redlers Patents Co., Gloucester.

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U.K. ELECTRICITY SUPPLY FIGURES

Increase of 9·7 Per Cent. Over the Year

During December, 1955, 6,757 million kW were sold by the Central Electricity Authority to the English and Welsh Area Boards. This was an increase of 9·7 per cent. over the figure for December, 1954. Allowing for the weather conditions and for the number of effective working days the increase was 9·1 per cent.

During the year ended December 31, 1955, 67,200 million kWh were sold, compared with 61,239 million kWh during the corresponding period of 1954, an increase of 9·7 per cent.

The amount of electricity sent out by the Area Boards during December, 1955, was also 6,757 million kWh, of which 166 million kWh were supplied direct by the Central Authority. The increases in the amounts sent out, compared with the corresponding figures in December, 1954, were 8·4 per cent. in the "mainly industrial" and 11·5 per cent. in the "mainly non-industrial" areas.

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TORQUE CONVERTERS

Three-stage torque converters are now being made in this country by Rolls-Royce Limited, 14-15 Conduit-street, London, W.1, under licence from the Twin Disc Clutch Company of America. Three sizes are to be produced giving a power range from 60 to 600 b.h.p. at speeds from 700 to 2,400 r.p.m. The sizes have been chosen to match the range of Rolls-Royce engines, and the firm emphasize the need for good matching both to the engine and to the application if the best results are to be obtained.

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THE STORY OF GAS

The Gas Council (Film Library), 1 Grosvenor-place, London, S.W.1, have prepared a series of 14 sound films supplemented by silent film strips and coloured wall charts on "The Story of Gas" for use in schools and some of which are suitable for use in technical colleges. The films cover the manufacture, distribution and utilisation of coal gas and are available on free loan from the Gas Council or from local gas showrooms; a minimum of a fortnight's notice is required.

A SHORT HISTORY OF GEARS

FROM ARCHIMEDES TO THE PRESENT DAY

By C. St. C. Davison, M.SC., PH.D.*

The success of a prime mover depends largely on the efficiency and reliability with which the power it supplies is transmitted, and it is not surprising therefore that the history of engineering is intimately linked with the history of gears and gearing. In this article the author outlines the development of gears through the ages from 330 B.C. to the present day, dealing generally with their use, design and manufacture.

ARISTOTLE'S FRICTION WHEELS

Aristotle described how a number of wheels with their centres on the same line and in peripheral contact one with another could all be made to rotate by turning one of them (330 B.C.). Wheels of brass and iron were made and dedicated in the temples, where they were rotated in this way. Aristotle's dialectic writings were probably the earliest records in which gear wheels were mentioned. In order that the metal wheels in line should turn without slipping, it could be assumed that a certain amount of pressure was applied to the rims of the wheels.

Gears must have become fairly well known by the third century B.C. for it is recorded that Ctesibius invented a practical and useful water-clock with gears (*c.* 250 B.C.); this clepsydra is illustrated in Fig. 1. It is told of Archimedes that he said he could set the earth in motion. A clue to the meaning of this statement was given by Pappus, the great mathematician in Alexandria, who explained that Archimedes meant that he would set the earth in motion with the worm-wheel, endless screw, and cog-wheel. Archimedes, therefore, must have had great faith in the gears of his time.

EARLY WATER-RAISING MACHINES

Another famous inventor was Philon of Byzantium who used gears on a perfume sprayer and on a water-raising device (*c.* 230 B.C.). The gears on the water-raising machine were very simple: a short cylinder had projecting radial arms and when it was rotated by a handle the arms came in contact with a series of wooden teeth on a vertical plunger which they lifted. Vitruvius mentioned gears that worked between two shafts at right angles on a water-mill, and the Romans had water-raising equipment with wheel-and-trundle gears at the same time. (*c.* 25 B.C.). An early water-raising device employing primitive gears is shown in Fig. 2.

* Assistant Keeper, Science Museum.

Fig. 1 Ctesibius's clepsydra (*c.* 250 B.C.). Gears must have been fairly common by the third century B.C. since this water clock made practical and comparatively efficient use of them. (Taken from *Hydraulics and Mechanics* by Thomas Ewbank, 1856.)

There was apparently not much development of gears after the fall of the Roman Empire. Records by Heron, Vitruvius and others would appear to have been lost. After the eleventh century, however, the records were gradually recovered and Latin translations became available here and there in manuscript copies. Arrangements of gears made of wood still remained simple and crude, however, but in the fourteenth century gear wheels made of metal appeared on tower clocks. More attention was paid to technology after the fifteenth century. This was to suit the needs of the times mainly in military engineering, navigation and architecture. The development of movable-type printing, which was invented about 1440, made possible cheaper books, and knowledge of applied science was disseminated through various countries. In 1588, A. Ramelli published a book entitled *Le Diverse et Artificiose Machine*, which included numerous references to gears. Figs. 3 and 4 show two of its illustrations: a water pump with crown wheel and pinion and gearing for shafts at right angles.

INVOLUTES AND CYCLOIDS

A new stage in the development of gears was reached in the second half of the seventeenth century, when scientific societies rose into prominence in Italy, France, England and Germany. Mathematicians began to apply geometric principles to arrive at the best shape for gear teeth. Existing gears shook and rattled on the machine and supplied a motion that was anything but uniform.

C. Huyghens contemplated involute and cycloidal curves for obtaining uniform impact with large pendulums. Basing his work on that of Galileo, he carried out experiments on swinging motion in relation to the pendulum of a clock he was designing. He fixed two pieces of metal cut to the cycloidal shape, one on each side of the pendulum thread. The pieces of metal pointed downwards and were fixed so that the suspension-thread gently touched each piece in turn and isochronous swings were obtained (*c.* 1665).

Philippe de la Hire was said to have made epicycloidal-shaped teeth although he considered the involute shape to be the best. He outlined the principles for the working of bevel-gears (1666). He showed also that it was not essential to have involute or cycloidal tooth forms, and that it was possible to transmit motion between gears with an infinite number of shapes. The shape of the driven tooth depended of course on the shape of the driving-tooth. O. Roemer while endeavouring to obtain uniform motion on his telescope also tried gears with epicycloidal-shaped teeth (1674).

CAST IRON AND GEAR CUTTING

It was remarkable that technicians did not bother in the slightest about the new theoretical dissertations, although a great deal of valuable information was imparted. It was well into the eighteenth century before the discoveries were given more attention. This was largely due to C. E. Camus and L. Euler. Camus explained how to draw the geometric shapes for teeth in a way that was easily understood (1752). Euler also drew attention to correct design, and he revealed that since the portion of the curves denoting the teeth was small, the involute and cycloidal curves could be replaced by arcs of circles which would give approximately the same shape and would be easier to draw.

Mill machinery was made of wood until about 1770, when cast-iron parts began to replace wooden parts. The metal gears were more accurately made than the earlier wooden ones. A template for the tooth-shape was constructed and the teeth marked on the gear blank. There

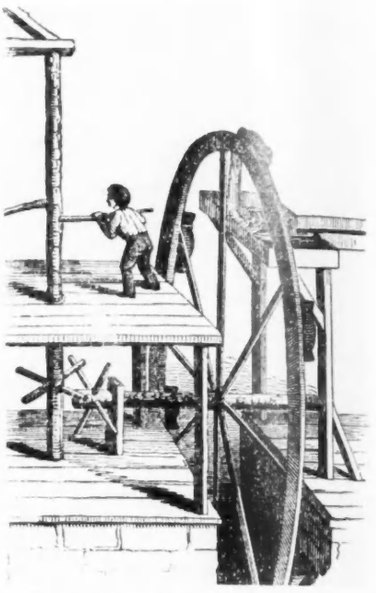

Fig. 2. Water-raising device with primitive gears. The Romans later developed improved water-raising equipment employing wheel-and-trundle gears about 25 B.C. (Ewbank, see Fig. 1).

were no machines for cutting the teeth in those days, and the accuracy of the gear wheel depended, therefore, upon the workman's manual skill and the correctness of his eye. James Brindley made a machine for cutting teeth (1776) and Jaques de Vaucanson made a gear cutter (1782) which resembled a rotary file. Clock makers, however, had small hand-driven tooth cutting machines 100 years earlier.

The development of the steam-engine at that time increased trade, and it was found necessary to have more skilled workers and more machines to hasten and cheapen production. Remarkable development of machine tools and machine-shop

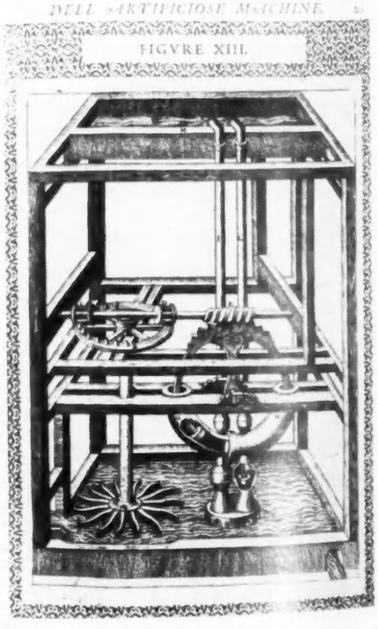

Fig. 3 Water pump with reversi[ble] crown wheel and pinion; note toroidal prim[ary] in pump. (Taken from *Le Diverse et Arti[ficiose] Machine*, by A. Ramelli, 158[8])

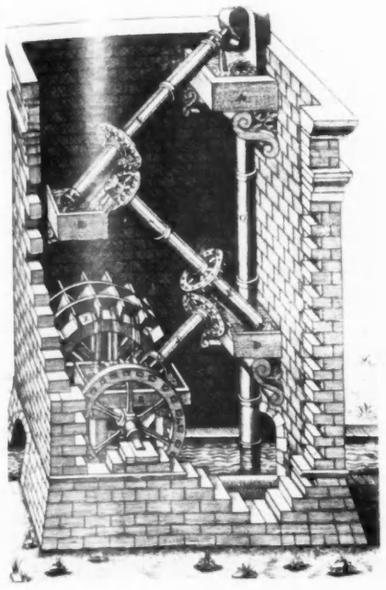

Fig. 4 Gears for transferring rotary motion through a right angle—system described by Ramelli in 1588. (See Fig. 3.)

processes took place in the first 30 years of the nineteenth century. The combination of the slide-rest, lead-screw, and change-wheels on lathes (*c.* 1800) by Henry Maudslay proved a great help and soon the planing-machine, the screw-cutting machine and others, were introduced into the workshops. These tools enabled the engineer to make parts which it had been impossible to make before.

Every subsequent improvement in machinery brought greater accuracy and economy in production. New rotating teeth cutters followed and hastened development. What appeared to be the first power-driven precision gear-cutting machine was built in 1855 by J. R. Brown, who then devised the first universal milling machine (1861). He later invented an improved milling cutter which could be sharpened by grinding without altering the shape of the cutting-face. Machine-shop practice was revolutionised by the milling process between 1890 and 1915. Probably no class of machine tools required greater ingenuity in design than gear-cutting machines. Contributions to the theory of gears and lubrication were made by several other well-known 19th Century scholars and engineers.

In the twentieth century the development of the motor car and the aeroplane made it imperative that gears should be silent and tough under rough usage and wear. Fig. 5 illustrates a Citroen double-herringbone gear (*c.* 1922) and Fig. 6 shows a David Brown single-reduction double-helical gear (1926). High-alloy steels

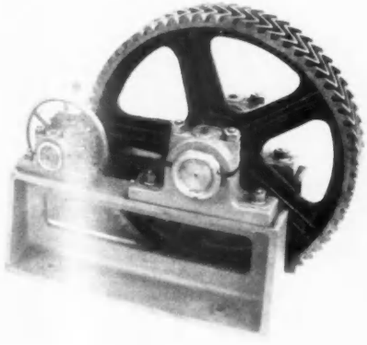

Fig. 5. C[illegible]n double-herringbone gear (*c.* 1922).

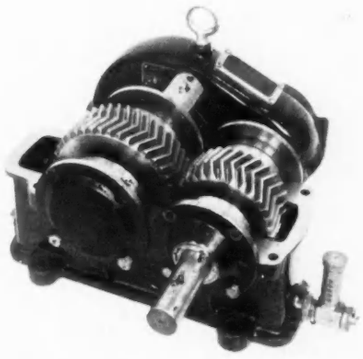

Fig. 6 David Brown single-reduction double-helical gear (1926).

were discovered and in conjunction with heat-treatment and case-hardening processes it was possible to make small and extremely efficient gears. Grinding-machines, which had been greatly improved in operation and speed since the beginning of the century, gave a high degree of finish after the teeth were heat-treated. It is in fact these refinements that have made possible the modern world of high-precision machine tools, mass-produced motor cars and supersonic aircraft. It would have been a remarkably clairvoyant Archimedes that could have foreseen the technical civilisation to which his speculations have led.

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POWER TRANSMISSION THROUGH THE AGES

Display at Science Museum

Exhibits illustrating the development of mechanical power transmission through the ages will be on view in Gallery III of the Science Museum, South Kensington, from next March 1. The display will include original examples, models and illustrations of gears, bearings, chain-drives and couplings, and will range chronologically from 250 B.C. to the present day. Many of the items referred to in the previous article will be exhibited and a catalogue of the entire collection, of which a representative part will be shown, has been prepared; it will be on sale in the near future. The Science Museum is open every day except Christmas Day and Good Friday, from 10 a.m. to 6 p.m. on weekdays, and from 2.30 p.m. to 6 p.m. on Sundays. Admission is free.

FIRES IN ELECTRICAL INSTALLATIONS

Relation of Age to Incidence

In 1947 the Electrical Research Association Sub-committee V/B (Fire Risks) agreed that an answer was urgently required to a question, posed by their chairman, Mr. H. W. Swann, whether there was an age at which electrical installations, and particularly domestic installations, might be supposed to reach the end of their safe useful life. After a consideration of alternatives it was decided that if a large group of installations, of which the age distribution was known, could be segregated and the age of each installation causing a fire call determined, then the number of fire calls per ten thousand installations of each age group could be found. Significant variations in this figure with the year of the installation should then indicate the effects of age.

A paper entitled "Age and the Incidence of Fires in Electrical Installations", which was read before the Utilisation Section of the Institution of Electrical Engineers by Mr. L. Gosland on January 19, gives a detailed account of an investigation conducted on these lines into fixed installations among a population of about 2·3 million consumers over the years 1951-53. It also analyses the information on the causes of fires, which became available during this work.

A total of 1,100 fires was surveyed in the course of the three years and as a result there was a strong indication that for installations connected before 1939 the incidence of fires increased with age. The fire incidence for installations connected during the post-war years at first seemed surprisingly high. The use of new techniques in building construction and installation practice in these years, however, introduced a number of new causes of fire, as is fully confirmed by the detailed information in the paper. Indeed, the data indicated that the chance that a fire would occur in a given installation in a given year was about seven in a million for each year of its age.

Of the total of 1,100 fires reported, 82 were due to defects in service equipment, the most common cause being the fuse, while of the 537 fires, on which there was sufficient information to enable the origin to be determined, 100 were due to defects in internal fittings, 47 of these being in the fuse, distribution board or control unit. Half the fuse-board fires occurred in the 12 per cent. of the installations connected after the end of 1945. Of the 18 per cent. of installations less than 10 years old only 3 per cent. suffered fires. In 210 fires out of 537 the primary cause was a defect in the fixed wiring, excluding temporary and unauthorised wiring, but including flexible cords. Figures showed that the risk of fire due to defective wiring increased with the age of the installation and post-war wiring gave rise to more trouble than would be expected from experience with older installations. Out of the 537 fires 54 were due to defects in unauthorised, temporary or amateur wiring, but contrary to expectation, 23 per cent. of these occurred on installations connected between 1941 and 1949. Of the 658 fires on which information was available 185 were associated with gas and nearly all arose from the passage of an earth fault current to a gas pipe and consequent ignition. The number of cases in which the current passed from the faulty appliance to the gas pipe by a third conductor, usually a water pipe or structural steel work was noteworthy. Faults in the earth continuity conductor caused 133 ignitions.

The author pointed out that there appeared to be a significant increase in the incidence of the number of fires with age of installation, but no indication of a departure from the linear rate. It was important to determine whether there was an age at which risks began to increase rapidly. Though at present unauthorised wiring did not seriously increase the overall incidence of fires, it considerably increased the risk in those premises in which it existed. While there were a very large number of types of equipment and defects which gave rise to fire, there was no single one to which attention could be directed.

HOW MECHANICAL ENGINEERS ARE EDUCATED IN RUSSIA

A VISIT TO MOSCOW REVEALS EXTENSIVE FACILITIES

By B. L. Goodlet, O.B.E., M.A., M.I.MECH.E.*

In November, 1955, a party of atomic scientists visited Moscow as guests of the Academy of Sciences of the U.S.S.R. I was one of this party and asked for a visit to an institute training mechanical engineers to be included in my programme. (It should be noted that I am familiar with the Russian language.) The present article sets out the information I collected and my impressions.†

MONOTECHNICAL INSTITUTES

The Moscow Higher Technical Institute (M.V.T.U.), named after N. E. Baumann, was founded as a trade school in 1830, converted into a higher technical institute in 1868, enlarged under new statutes in the nineties and, after the revolution of 1917, expanded into an institute of the polytechnic type.

In 1932 the Russian Government decided to abolish polytechnics and educate specialists in monotechnical institutes having close ties with the appropriate branch of industry. In conformity with this decision the M.V.T.U. faculties of electrotechnics, aviation, structural engineering and chemical technology broke away as independent institutes on other sites, and the M.V.T.U. was left with the basic job of turning out mechanical engineers for the heavy machine industry. The budget of the school just after this change was 8·3 million roubles per annum (about £0·83 million sterling), while in 1937 26 million roubles were voted for extensions. The output in 1934 was 450 graduates. During the war the Institute was evacuated from Moscow but without serious interruption of its work. Since the war there has been steady expansion and at the present time there are about 10,500 full-time students and a teaching staff of 700. In 1955 the Institute celebrated the 125th anniversary of its foundation and was awarded the Order of Lenin for its long and excellent record of service.

The principal faculties and constituent chairs existing in the Institute at the present time are listed in Table I. There may be some minor inaccuracies regarding the distribution of chairs among faculties, but the list is otherwise a fair indication of the organisation.

TABLE I.—*Faculties and Chairs, the Moscow Higher Technical Institute.*

I. *Faculty of Thermal and Hydraulic Machines*
- Chair of Boiler Engineering
- " " Steam Engines
- " " Steam Turbines
- " " Gas Turbines—Land and Mobile
- " " Gas Turbines—Aviation
- " " Internal Combustion Engines
- " " Refrigerating Machines and Compressors
- " " Low-Temperature Work
- " " Hydraulic Machines and Turbines

II. *Faculty of Machine Construction*
- Chair of Strength of Materials
- " " the Theory of Mechanisms and Machines
- " " Machine Details
- " " Hoisting and Conveying Machinery

III. *Faculty of Precision Instruments*
- Chair of Horology
- " " Calculating Machines
- " " Precision-Instrument Design
- " " Optical Instruments
- " " Metrology
- " " Special Instruments
- " " Precision-Instrument Technology

IV.—*Faculty of Transport Machines*
- Chair of Locomotive Engineering
- " " Automobile Engineering

V.—*Faculty of Mechanical Technology*
- Chair of the Technology of Machine Construction
- " " Machine Tools
- " " Welding and Flame Cutting
- " " Pressure Working of Metals

VI. *Faculty of Metal Technology*
- Chair of Metallurgy and Heat Treatment
- " " Foundry Technology

* Deputy chief engineer, Atomic Energy Research Establishment, Harwell; on April 1 he takes up an appointment as chief engineer and a director of the Brush Electrical Engineering Company, Limited; formerly Dean, Faculty of Engineering, University of Cape Town, and Professor of Electrical Engineering, University of Birmingham; chairman, Naval Education Advisory Committee, Admiralty.

† An American report on technological education in Russia was summarised in ENGINEERING on January 13 (page 40).

HIGH DEGREE OF SPECIALISATION

The whole course of study totals about 4,870 hours of instruction spread over 5½ years of full-time attendance, and the qualification awarded is that of Mechanical Engineer. The general plan is that all students take the same courses in the first three years, have some common courses in the fourth year, and during the fifth and sixth years concentrate on some specialised branch of mechanical engineering; the last half year is spent on a design project in that branch. A list of some of the 23 specialisations available is given in Table II.

TABLE II.—*Subjects in which Students Specialise.*

- Boiler engineering
- Turbine engineering—steam
- " " gas
- " " aviation
- Refrigerating engineering—refrigeration plant
- " " compressor design
- " " low temperature work
- Hydraulic turbines and hydraulic machines
- Internal-combustion engines
- Optical-mechanical instruments
- Precision instruments—horology
- " " metrology
- Thermo-technical measuring instruments and controllers
- Hoisting and conveying machinery
- Transport Machinery—locomotives
- " " automobiles
- Welding and flame cutting
- Foundry technology
- Pressure working of metals
- Metallurgy and heat treatment

This list shows that the degree of specialisation required of a Russian mechanical engineer at graduation is much greater than would be regarded as proper at any British university. It should, however, be noted that this specialisation is achieved by a longer period of study and does not imply that insufficient time is spent on the teaching of fundamentals. The common courses taken by all students occupy some two-thirds of the total teaching time, and the time spent on basic subjects is as great as in British university courses. This will be clear from the approximate time schedule of the common courses which appears in Table III.

TABLE III.—*Schedule of Common Courses*

Subject	Total hours	Group hours
Group A		
Mathematics	416	
Physics	245	
Chemistry	120	
Theoretical mechanics	215	
Electricity	162	
Applied heat	90	
		1,248
Group B		
Geometry	90	
Drawing and machine drawing	188	
Details of machines	215	
Theory of machines	197	
Strength of materials	232	
		922
Group C		
Technology of metals	182	
Metallurgy and heat treatment	96	
Instructional workshops	204	
Workshop measurements and interchangeable manufacture	48	
Industrial safety and fire drill	40	
		570
Group D		
Political economy	140	
Industrial economics, organisation and planning	95	
History of technology	39	
Foreign language	134	
		408
Group E		
Fundamentals of Marx-Leninism	252	252

The total time spent on Groups A, B, and C is some 2,740 hours. Group D includes subjects of considerable educational value often missing in British engineering curricula. Group E may be ridiculed as political indoctrination, which it undoubtedly is; it might however be more profitable to think of it as the Russian equivalent to a set of lectures on the British Constitution and the working of our Government machine, which would undoubtedly be regarded as a highly educative addition to the average British engineering syllabus.

DIPLOMA PROJECT

The culmination of the course is the "diploma project," which occupies some 20 weeks of the final year. The problem presented is usually the design of an engine, crane or other machine appropriate to the student's specialisation, and this has to be worked out in great detail leaving nothing to the imagination. I looked at several diploma-project reports and was surprised at the excellence of the draughtsmanship. One of these reports dealt with the design of a motor cycle with fluid transmission and I was particularly impressed with the care taken to work out and specify all the operations of its manufacture, over and above the many problems of the design itself. We were told that before starting his diploma project a student spent a few weeks in a factory which made the kind of machine he would be expected to design.

The great importance attached to knowledge of workshop processes and machine-tool operations was apparent both in the diploma reports and in the workshops and laboratories, the equipment of which was excellent.

ENTRY STANDARDS AND GRANTS

We asked how entrants were selected, and were told that admission was by competitive examination at the age of 17-18; there were always several times more applicants than vacancies. Admission was easiest to the specialisations with a pronounced workshop flavour—for example, forging and pressure working of metals; "white collar courses" such as turbine design were always over popular. I was told that the calculus was not taught in the schools, which put their entry standard probably a year behind that of our grammar-school leavers. However, students have to work extremely hard and there is a lot of homework. Students who fail a course examination are allowed to try again after the vacation but are rejected on failing twice.

Admission to a higher technical institute is a qualification which exempts the successful candidate from military service. The physical education and sport which for students replaces military service occupies only 134 hours in 5½ years. We asked where the armed forces obtained their specialists from and were told that they were trained in special service schools.

Students at the M.V.T.U. receive a State stipend of 300 to 500 roubles per month. In cases of exceptional merit the stipend can go up to 600 roubles per month. The precise sum is fixed by the Principal, having regard to: (*a*) the year which the student has reached; (*b*) the specialisation (the rougher options such as pressure working of metals carry higher stipends); and (*c*) the quality of the student's work. All stipends are awarded without regard to parents' income and social origin. Really outstanding men are eligible for one of the 100 Stalin Premia, valued at 800 roubles per month, in the gift of the Principal. Cases of hardship can be helped from a special fund also controlled by the Principal. Students are expected to pay fees which vary between 200 and 400 roubles per annum, but exemption can be obtained by making good progress. The value of the rouble can be roughly fixed from the statement that the wage of a skilled workman in Moscow would be approximately 900 roubles per month. It is, however, improbable that students living in hostels pay the full value of their maintenance.

ADVANCED STUDY AND RESEARCH

We gathered that graduates were expected to spend three years in the industry on their specialisation. After this they could if they wished embark on a research career by applying for admission as aspirant at one of the many teaching or research institutes. The higher degree of

Candidate in science (perhaps equivalent to Ph.D.) is open to aspirants of three-years standing. The standard of the ultimate degrees of Doctor of Science or Doctor of Technical Science seems to be very high. The present number of aspirants at the M.V.T.U. is around 200; about one-third of these are brilliant students who were admitted as aspirants directly after graduation and without working in industry.

Each faculty has its own research programme, which is planned in close collaboration with the factories with which the faculty is linked. To the writer the most interesting and significant feature was the amount of research in progress in the fields of theory of mechanisms and machines, design of machine details, machine tools, and technology of machine construction. One has the feeling that in Russia science has closer links with drawing office and workshop practice than is the case in England.

Another point of interest is the large number of excellent, up-to-date and advanced text-books available to Russian engineers. The writing of such text-books is listed among the important research achievements of the staff, showing the great importance attached to good teaching.

SCIENTIFIC APPROACH TO WORKSHOP

The present set-up of the M.V.T.U. is the product of history and Communist philosophy. It is an accident of history that most continental universities refused to admit the ignoble art of engineering to their disciplines so that special higher technical institutes had to be set up for the training of engineers. These new technical universities had to set high standards in science in order to compete in standing and prestige with the older foundations. However, not having to conciliate the arts faculty, they could also teach real engineering—not merely bastard science.

In England, where the art of engineering was pioneered by craftsmen, the need for teaching workshop technology was hardly felt; the demand was for simple science to aid the practical engineer.

In Russia, however, industrialisation was imposed from above; there was no large pool of craft skill, and workshop technology could not be learnt from peasants. Russian engineering curricula have therefore always included a much larger amount of instruction in machine design and workshop technology than has been hitherto thought necessary in England. We have, however, now entered a new era in which workshop methods are no longer empirical, but are the result of scientific and operational research. In this new era workpeople are no longer reliable teachers for our student engineers and the traditional Russian policy of giving formal instruction in machine tools, workshop technology and production methods is likely to be the key to the future.

TECHNOLOGY UNDER COMMUNISM

Communism is defined in my dictionary as a doctrine advocating the common ownership of wealth. However, wealth has to be produced before it can be distributed and practical Communism seems to be much more concerned with production. Nowadays, wealth is produced by means of machines, which therefore occupy a special position of honour in Communist philosophy. The machine which produces wealth and lightens human toil, the machine tool which produces the machines, the prime mover which supplies power, electricity which transmits and applies power, the transport system which moves produce to where it is needed, these are the pillars of the Communist system. It is, therefore, hardly surprising that the design, construction and technology of machines should occupy a prominent place in the Russian engineering curriculum. Moreover the Communist prophets regarded science as the ultimate wisdom and used "empirical" as a term of abuse. It is therefore not surprising that the Russian approach to workshop technology should be strictly scientific.

Opinion on the desirability of educating engineers in monotechnic schools will undoubtedly differ. The writer's view is that the Russian syllabus of common lectures is as broad as that of most British university engineering schools and, provided these lectures are not given by people with a monotechnic outlook, the fact that the listeners have a common interest will hardly matter. The question of size is also very relevant—if one wishes to teach very large numbers (10,000 at the M.V.T.U.) the monotechnic institute probably has a lot to recommend it.

Russian engineering curricula are clearly designed to convey a lot of useful information. Probably they have to be of this pattern in order to satisfy the Minister of Higher Education who must approve them. One wonders if this Minister realises the distinction between what is taught and what is absorbed and whether he knows that students sometimes learn more when they are taught less. With organised instruction filling up to 36 hours per week and "plenty of homework," one wonders when students find time to do anything they are not told to do, and whether their originality and initiative does not atrophy under this discipline.

Certainly Russian scientists, as distinct from engineers, sense a touch of the "conveyor belt" about their curricula and wonder whether our own less overloaded honours courses may not be a better foundation for a research career. There does not, however, seem to be much wrong with Russian research, so their good men must get through in spite of defects in their schooling. If one assumes that good men cannot be spoilt, there is something to be said too for designing a curriculum to cater for the much larger number of average men who learn nothing they are not taught, but who can be taught to be useful engineers. Is it not permissible to suggest that the real object of education is to enable one to function effectively at least one grade above one's natural intellectual level?

GROUNDING IN FUNDAMENTALS

To summarise, I have no reason to think that the Russian graduate engineer is less well grounded in fundamentals than our men. I am certain that he gets a better grounding in engineering drawing, design and manufacturing technology, and is therefore useful to his employer with less further training than our men need. The study of some particular branch of mechanical engineering is, however, largely wasted time unless the graduate does in fact find employment in that branch—and this would be much more difficult to guarantee in England than in Russia.

The production of the cadres of technical specialists at an expanding rate is a cardinal point of Communist doctrine. The present rate of production of engineers from the Russian higher technical institutes may now be around 60,000 a year. The best figures I have been able to discover are given in Table IV.

TABLE IV.—*Numbers of Engineers Trained in Various Periods*

Period	Output of Engineers	
	Total	Yearly average
1938-41 (3½ years)	116,500	33,500
1941-45 (4½ years)	41,690	9,300
1945-50 (5 years)	170,000	34,000
1951-55 (5 years)	160,000	52,000

The term "engineer" in Russia (and generally on the Continent) implies a man with a qualification of degree standard conferred by a higher technical institute, usually demanding 5½ years study. Since some of the large factories in Russia have technical schools affiliated to the nearest higher technical institute it is probable that some of the engineers listed above graduated by part-time day and evening studies, but I do not think that this fraction is large. The training of technicians is another matter, to be discussed later. On the matter of the rate of production of men trained for research, I have seen it stated that the fourth five-year plan ending in 1950 produced 15,500 young scientific workers trained via the aspirantura and that the fifth five-year plan aimed at doubling this number.

The technician is the warrant officer of industry and occupies an honourable position in the hierarchy without any pretence of being a fully qualified engineer. The various kinds of technician and the range of knowledge and skills each must possess are clearly defined, and special text-books are written to assist each kind to qualify.

TRAINING TECHNICIANS

The training of technicians is carried out (*a*) in technicums and (*b*) in night schools. (No school for training technicians was visited.) The technicum is a day school giving specialised courses of up to three years duration with normal entry at age 16 to 18, after seven or ten years schooling. There are also, however, evening departments catering for working people. Each technicum is associated with a particular group of industries; for example, ferrous metallurgy, machine-tool construction, precision instruments, etc. Some of the specialisations noted were: technician geophysicist, technician metallurgical furnace expert, technician wire rope maker, technician electroplater, technician metal cutting expert, technician electrical tester, and technician steel melter.

Equipment for practical instruction is stated to be good. The passing-out standards of technicians are controlled by the State Commission on Qualifications (which passes comments on individual students) and there is no reason to believe that standards in technicums are not high.

It is, however, clear that large numbers of "specialists" are also produced by evening studies. I noted a statement that in 1954 there were 3 million evening students including those studying farming specialities. I also read an account of one workman who, starting as an electrician's mate, had obtained a qualification by evening study, had risen to be chief mechanic of a large works, and was preparing to defend a dissertation for the degree of Candidate of Technical Science. It appears, however, that this degree of self-advancement is unusual.

CRAFT TRAINING

I am uncertain how the time-honoured method of apprenticeship operates in Russia, if at all. I suspect it has been replaced by intensive training in trade schools attached to various works. One article describes a well-equipped trade school giving intensive one-year courses for turners, assembly fitters, repair fitters, electricians, metallurgical-laboratory workers and draughtsmen. Young people of both sexes who pass these courses apparently then go straight on to production under the supervision of more experienced workers. The Works League of Young Communists (Komsomol) were told to arrange a recruiting party for school leavers at which the chief constructor and others set out the advantages of working at a trade.

It is interesting to note that everything possible is done to emphasise the dignity of manual work and individuals are referred to as "the distinguished turner-innovator Comrade—" or "the distinguished furnace repair fitter the Stalin Laureate Comrade—" Another feature noted at all institutes visited is the "Notice Board of Honour" which displays for six months the photographs of workers commended for some special achievement or general good work. Information about innovations and praise for the innovators is disseminated from the "House of Scientific-Technical Propaganda" in Leningrad. There also seems to be a special output of books for young people describing, in the guise of a story, the attractions of work in industries which happen to be short of labour. It is also worth noting that there are at least seven gradations of pay between ordinary and top-grade workmen, based on skill and achievement. This all seems to be pretty good psychology and we can perhaps learn something from the Russians in this as in other fields.

I cannot conclude without saying that the kindness and hospitality of our hosts was overwhelming and I shall preserve the pleasantest recollections of our visit.

Book Reviews

MACHINES TO TRANSLATE LANGUAGES

Machine Translation of Languages: Fourteen Essays. Edited by WILLIAM N. LOCKE and A. DONALD BOOTH. Published jointly by the *Technology Press of the Massachusetts Institute of Technology* and *John Wiley and Sons, Incorporated*, 440 *Fourth-avenue, New York* 16, *N.Y., U.S.A.* (6 dols.); and *Chapman and Hall, Limited*, 37 *Essex-street, London, W.C.2.* (48*s.*)

English-speaking scientists and engineers are, linguistically, a very favoured group. Half the world's scientific papers are written in our language. Even so, to know how the other half lives, and thinks, and designs, is vital for a progressive science and technology. Men have long dreamt of a universal language. More practically, they have long struggled with the problem of translation, inching their way through a foreign text with a dictionary. If only we had a machine to do the job!

Nine years ago, in a letter to Dr. Norbert Wiener, another expert in communication theory, Dr. Warren Weaver, mused upon the problems of language. "When I look at an article in Russian," he wrote, "I say: this is really written in English, but it has been coded in some strange symbols; I will now proceed to decode it." He continued, "is it unthinkable to design a computer which would translate?" Weaver had in fact discussed the thought with Dr. A. D. Booth of Birkbeck College the previous year, and the latter had already started to experiment.

Mechanical translation is only a decade old. The first aim was to construct a mechanical dictionary to assist in the tedious operation of looking up the meanings of unfamiliar words. Gradually, the sights have been set higher. To the stem dictionary should be added an ending dictionary, and—more sophisticated still—a "syntax analyser" which would interpret grammatical features of the input language into those of the output language by changing word order, dropping or adding endings, etc. Finally, both input and output might be mechanised.

By 1952, nearly twenty scientists and linguists were doing work on the problem, and a conference was held at the Massachusetts Institute of Technology. The papers given there, since revised and supplemented by later work, form the basis of this book, which contains 14 essays and a bibliography of 40 other papers. Many of the essays are not easy reading. They are research papers and written for other specialists. Rather than a detailed enumeration of their contents, an exposition of the general principles may be more appropriate here.

The book makes it clear that the future prospects of mechanical translation depend on five main factors—two engineering and three linguistic. The central engineering problem is the development of really large and cheap storage units to hold the stem dictionary. If a machine is to be capable of translating any passage from, say, German, a storage capacity of several million words might be needed, with correspondingly long search times. For this purpose, storage on punched cards, magnetic tape or photographic film would be indicated. If the vocabulary of any one machine set-up were restricted to a fairly narrow scientific field, a storage capacity of ten thousand words on a magnetic or photographic drum might suffice.

Apart from dictionary storage, the machine would need a rudimentary computer, capable only of subtracting, rearranging, and recording results in the storage, and a small-capacity transient storage. The second engineering problem is that of an input device, a "mechanical recogniser," which could scan print or typescript or even dictated speech, and transmit a coded transform of the text to the translating machine. Though such devices are under development, input is at present carried out manually by inscribing the input text in appropriately coded form on a feed tape or punched card.

By way of introducing the linguistic problems, let us examine the kind of operations which a mechanical translator would perform. A coded text, such as the Russian sentence "velichina ugla opredelayatsya otnosheniem dlini dugi k radiusu," is fed in letter by letter. The letters are held in a transient storage unit until the coded space signals the end of the first word. The machine then searches its stem dictionary for a coded pattern equivalent to "velichina." Associated with this word in the dictionary are coded one or more English equivalents, and perhaps code numbers directing the machine to select one of these equivalents under certain circumstances. In this case, let us assume only one English word is coded, "magnitude." The machine records this on the output tape, clears its transient storage unit, and proceeds to record the next word, "ugla."

Once again the stem dictionary is searched, but this time no equivalent is found. The machine then strips off the last letter of the word, and searches for "ugl." This is found to have, say, two English equivalents, "coal" and "angle." Associated with it is a code number which instructs the machine: if the code number of the ending is 221, translate as "coal"; if it is 222, translate as "angle" and reverse the order of output words. The machine then holds "ugl" in its transient storage unit, and searches its ending dictionary for the stripped letter "a." It finds that it is associated with the English equivalent "of" and with code number 222. The machine then records "of angle" on the output tape, and clears its transient storage unit. So the translation proceeds, until the output has received the English sentence, "magnitude of angle is determined by relation of length of arc to radius."

The first of the three linguistic problems which mechanical translation presents is to reduce the size of the stem dictionary. Complete coverage of a language would require storage of several hundred thousand stems, each associated with, say, ten English equivalents. Search times would be very high. It appears much more practical to construct a series of small dictionaries, each restricted to a few thousand stems used in a relatively narrow field of knowledge. It appears, for example, that some 3,000 entries would take care of almost all the words occurring in Russian mathematical papers. The first linguistic problem is therefore to study the literature of particular subject fields and to compile specialised glossaries of the words there encountered. Each stem dictionary would then contain only a few thousand words, and the number of English equivalents for any term would rarely be numerous.

Next comes the problem of endings. For an inflected language, such as Russian, is it necessary to store and give an English equivalent for every ending? Consider the words "k radiusu" in the sentence given above. The preposition "k" already provides the output equivalent "to," and the ending "u" adds nothing to the translation. In one paper in the book reviewed, Mr. K. E. Harper analyses scientific Russian, and concludes that noun endings can be disregarded for the nominative, dative, accusative and prepositional cases, though they should be retained for the instrumental and genitive cases. Analyses of this kind may considerably reduce the size of the ending dictionary.

Lastly, there is the problem of syntax analysis. For this, the machine must take into account not only the English equivalents of a stem and its ending, but also neighbouring words, before deciding on its output. An example of an ending determining the choice of English equivalent has already been given ("ugla"). As an example of word context we might take Harper's observation that, if two Russian nouns follow each other, 93 per cent. of the time the second noun is genitive. Thus, in the sentence given above, "dlini dugi" means "length of arc." This case might be met by giving to all stems of nouns a code number which instructs the machine as follows: if the previous word is also a noun, insert "of" before the English equivalent of the present word, unless the ending directs otherwise. This general problem of syntax resolves itself into dividing up the words of a language into classes, each of which stands in a definite grammatical relation to other classes.

It has only been possible to outline here, in very general terms, problems that are discussed in considerable detail in this interesting symposium. One last point should be made. Mechanical translation is still largely in its theoretical phase. On the practical side, it is reported that at Birkbeck College an electronic computer has been used to translate into English passages of about 40 words from over 20 languages. In America, an I.B.M. punched-card computer was set up with a 250 word vocabulary and six syntactical instructions, for translating short passages of Russian. The engineering and linguistic problems yet to be solved are formidable but fascinating. The varied and even contradictory views expressed in this book reveal both the immaturity and the fertility of this new field. It is recommended to all who are interested in the complex problem of human communication.

★ ★ ★

BOOKS RECEIVED

Some of the books noticed here are selected for extended review in ENGINEERING.

Report on Frost Resistance of Concrete and on the Definition of Concrete Mixes. Submitted by the International Sub-Committee on Concrete for Large Dams. *British Committee on Concrete for Large Dams, c/o Building Research Station, Garston, Watford, Hertfordshire.* (10*s.*)

This report contains ten papers on the problems of placing concrete under cold conditions. The papers are discussions of laboratory studies of the contribution of the factors concerned, such as the nature of the cement used, aggregate size and so on. Particular emphasis is placed on the method of carrying out the freezing and thawing tests involved, one of the papers dealing with non-destructive methods of observation. Though prepared for the International Committee on Concrete for Large Dams, the subject is of far wider interest. The eleventh paper "Definitions of Concrete Mixes used in Dam Construction" has been published on page 125, in the issue of February 3, and is intended to serve as a model for describing concrete used in all types of constructional work.

Tungsten: Its History, Geology, Ore-Dressing, Metallurgy, Chemistry, Analysis, Applications, and Economics. By K. C. LI and CHUNG YU WANG. Third edition. *Reinhold Publishing Corporation, 430 Park-avenue, New York 22, N.Y., U.S.A.* (14 dols.); and *Chapman and Hall, Limited*, 37 *Essex-street, London, W.C.2.* (112*s.*)

Mr. K. C. Li, who is an Associate of the Royal School of Mines, London, and is credited with the discovery of the occurrence of tungsten ore in China, is now chairman of the Wah Chang Corporation and chief engineer of the Wah Chang Smelting and Refining Company of America, Inc. Dr. C. Y. Wang is director of research of the Wah Chang Corporation. As stated in its title, the book deals in detail with the history, geology, methods of ore dressing, metallurgy, chemistry, analytical determination, industrial applications and economics of tungsten. In the chapter on industrial applications are set out detailed lists of commercial steels and ferrous alloys containing tungsten. Additional commercial information and statistics, including a list of references relative to tungsten alloys, are given in appendices.

The Generation of Electricity by Wind Power. By E. W. GOLDING. *E. and F. N. Spon, Limited, 22 Henrietta-street, London, W.C.2.* (—) Reviewed on page 115, in the issue of February 3.)

The Engineering Outlook—5

MACHINE TOOLS

FULL ORDER BOOK LENGTHENS DELIVERY DATES

Last year there was an increase in gross capital formation in the U.K. of some 10 per cent. This could not have been accomplished without a large expansion in factory building and a sharp increase in the number of orders placed for machine tools and equipment. The investment boom, generated by the expansion plans of the engineering industry, particularly the motor car, aircraft and electrical sections, made 1955 a record year for the machine tool industry and it seems probable, to judge by the present length of the order book, that output will continue to expand for at least the next fifteen months.

In the second quarter of 1955, new orders for machine tools, at £25·7 million (Table III) reached the highest level since the war, and were 45 per cent. above the corresponding period in 1954. In the third quarter of 1955, this figure dropped to £22·6 million. This may have been due to the initial effects of the credit squeeze, but it can be seen from Table III that with the exception of 1954 there is normally a fall in new orders in the autumn. In the last two months of 1955, demand strengthened considerably, and manufacturers expect a strong market for machine tools in 1956.

ADVANCES IN AUTOMATION

To some extent the spate of new orders for machine tools in 1955 must be attributed to the introduction of investment allowances in the 1954 Budget, and increased investment tends to produce a chain reaction. The incentive for one sphere of industry to re-tool must in its turn provide a similar incentive to suppliers of its components, and a snowball effect is engendered. The most notable examples of this trend last year were the large expansion plans of the motor vehicle and motor components industries, some of which were described in ENGINEERING last autumn (issues of October 14 and 28, pages 524 and 588). This, however, was only one example of the movement. The strongest demand for machine tools continued to come from the heavy engineering and electrical industries, and this was particularly reflected in increased orders for general-purpose semi-standard tools capable of batch production. The continuing labour shortage served to intensify this trend, and the interest taken during 1955 in automation is also resulting in increased demand for the products of the machine tool industry. A spokesman of the Renault Company spoke about the increasing move towards automation to the Institution of Production Engineers, at Margate in June, 1955, and in October a proposal was made by the Production Engineering Research Association to carry out a programme of research on automation. While the scope of this research programme is narrow (ENGINEERING, October 14, 1955, page 523), any move towards constructive research in automation is welcome.

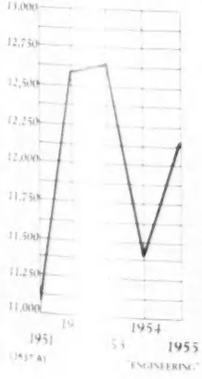

Fig. 1 United Kingdom deliveries of metal-working machine tools; monthly averages in tons.

Meanwhile, James Archdale Limited, have continued to pioneer design and construction of the type of machine which carries out a series of different operations upon workpieces, passing it on from one cutting head to the next. Wickman Limited also sold several machines of the automatic transfer type, and several British companies are developing in this field. The chairman of C.V.A. Jigs and Moulds Limited was able to tell his shareholders that the company was "well in the forefront of automation developments." Other companies building automatic transfer machinery include B.S.A. Tools, Limited, the Asquith Machine Tool Corporation, Limited, Sentinel (Shrewsbury), Limited, and Frederick Pollard and Company, Limited. Progress has also been made in the field of electronic controls, and an interesting development was the system introduced by E.M.I. (Electronics) Limited, and described in ENGINEERING, December 2, page 769. Installed at the Norwich factory of Laurence Scott and Electromotors Limited, this system has been applied to copy-milling machinery which produces finished prototypes from information fed to it by a perforated paper tape. The greatest advantage claimed for this machine is that it is said to make possible the production of a single prototype immediately the design is finished at no extra cost than is incurred in the normal manufacture of a mass-produced part. Moreover, the time taken to produce a particular component by this system is said to be reduced from six weeks to two hours operating time.

A rapid rate of development of new and improved equipment results in many machines becoming obsolete more quickly. To keep abreast of new developments, machine tool users must therefore maintain a continuous demand for new products in order to maintain their competitive position relative to both home and foreign competitors. While this trend is obviously advantageous to the machine tool industry as a whole, it also emphasises the need for the latter to be able to give quick delivery. In 1955, lengthening delivery dates following the growth in the value of new orders caused foreign customers to go elsewhere if they wanted their equipment quickly. This was probably one of the main reasons why new orders from abroad did not expand nearly so rapidly as did those from the home market.

FEWER EXPORTS TO AMERICA

Total exports of metal working machine tools by countries for the years 1953 to 1955 are shown in Table I, while Table II shows exports divided according to types of machine. While there was a slight increase in total exports, the continued decline of exports to North America is disappointing. In 1953, Canada imported machine tools from the U.K. to the value of £3·25 million, but there was some over-buying in that year. By 1955, this figure had fallen to £1·23 million, while exports to the U.S.A. also showed a decline in 1954 and 1955. The dollar market, while being the most valuable export outlet for the country as a whole, is likely to become even more competitive in future. U.S. manufacturers, who occupy a leading position in the design of the more complex machine tools, are adopting electronic controls to an increasing extent and, in addition to raising their share of the U.S. market, are well placed to expand exports to Canada. British manufacturers, if they are to hold their own in North America, must be quick in introducing and demonstrating up-to-date tools and equipment to the American market.

During 1955, there was a marked improvement in U.S. demand for machine tools, and in

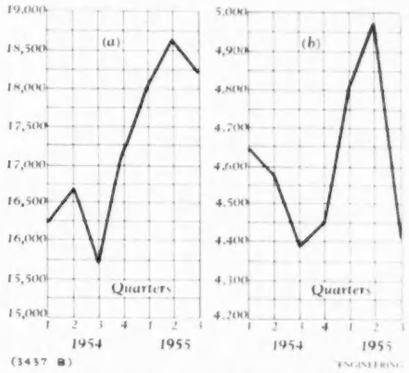

Fig. 2 Quarterly values of United Kingdom deliveries of machine tools in £1 thousands. Fig. 2(a) totals and Fig. 2(b) exports.

July, 1955, new orders placed for machine tools by U.S. industry were the highest for 21 months. There is, of course, often an appreciable time lag between the placing of new orders and delivery of machine tools, and it is possible that the low level of exports to the U.S.A. in 1955 resulted from the decline in demand in that country in 1954. That there were also a number of other factors outside the control of manufacturers in this country, however, is shown by the fact that in September, 1955, a committee was set up in the U.S.A. to examine the criticism that contracts were being given to high-cost U.S. companies instead of to their U.K. competitors, although the latter could in general offer a much lower price range. Some greater freedom of trade may be hoped for in the future if schemes recently announced by President Eisenhower come into effect.

Some British manufacturers found difficulty in securing export orders in 1955 on account of the long deliveries which they were forced to quote. The chairman of the Scottish Machine Tool Corporation Limited, at the annual general meeting in June last year, noted that intensifying competition from abroad was being made more evident by the long delivery dates which had to be offered by United Kingdom manufacturers as a result of calls upon them from the home market. The chairman of Charles Churchill and Company, Limited, said that "there was much room for improvement in Canada" and also attributed declining demands from that source to long delivery dates. An almost universal note was that the overseas market was no longer a sellers' paradise.

GROWING EUROPEAN COMPETITION

German competition has, of course, always been an important factor in export markets, and German exports again expanded in 1955. The export ratio of the German machine tool industry was estimated in September last year at about 50 per cent. of total output. In 1955, the Germans began to export automatic transfer machinery for use in motor car and other engineering plants, and the stands exhibiting forms of automatic control were among the centres of attraction at the German Machine Tool Exhibition held at Hanover last year. While German competition has been much in evidence throughout 1955, delivery dates are, however, lengthening in common with those of most other countries, and it may well be that British manufacturers can expect less intense competition from this source in 1956. There is still no cause for complacency, however. Germany appears to be making more headway in the important field of automation—and this will be a significant asset for all markets in the future. It is interesting to note that while exports of U.K. machine tools to Germany rose by 350 per cent. by weight in 1955, the value exported rose by only 60 per cent. This suggests that Germany may be buying the simpler and less expensive types of machinery abroad in order to concentrate her

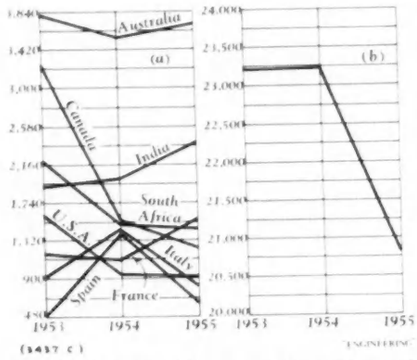

Fig. 3 Value in £1 thousands of machine tool exports. Fig. 3 (a) according to countries and Fig. 3 (b) total to all countries.

capacity on the development of more complex machine tools involving up-to-date improvements and electronic controls. There is very close co-operation between the electrical industry and machine tool manufacturers in Germany. Exports of British machine tools to Norway, Spain and Italy declined in 1955, and at least part of the decline must be attributed to intensifying German competiton.

RUSSIAN AND MIDDLE EAST MARKETS

Particularly encouraging from the viewpoint of the export trade was the rapid increase in sales to the Soviet Union. In 1954, Russia was 14th in order of importance amongst export customers. In 1955, however, as a result of a rise in the value of exports of £360,000 to £619,000, the U.S.S.R. became 10th in order of importance on the British machine tool export list. Russian requirements of machine tools are likely to grow as the concentration upon heavy industry announced recently under the new Soviet five-year plan becomes more marked, and there are also likely to be good prospects for an expansion of exports to the Eastern European market as a whole. Since the beginning of 1956, Hungary, Rumania, Poland and Czechoslovakia have all announced that plans for future industrial expansion will be concentrated on investment in heavy industry. The growing market east of the Iron Curtain—from Leipzig to Moscow—promises increasing importance during the next two or three years, although British manufacturers may meet strong competition from both East and West Germany, and trade with Eastern Europe will in any case be limited by the shortage of sterling possessed by those countries. It seems somewhat illogical that while trade to Russia is expanding, a complete embargo remains upon exports of machine tools to China, which might well provide a valuable export outlet.

Taking into account the financial assistance received by Middle and Far East countries, it is disappointing to note no substantial increase in exports to these countries. Indeed, except in the case of India, exports to these areas have declined and it is important that British manufacturers should watch investment developments under such schemes as the Colombo Plan and other internationally financed projects. In the past few months, large investment schemes have been announced by India, Pakistan, Israel, Jordan, Afghanistan, Malaya, Ceylon and Egypt.

Although in many branches of the industry there was little need to make a sales drive during 1955, attendance at specialised exhibitions is an important means of obtaining export orders. In 1955, interest was centred on exhibitions organised by the German and U.S. industries but it will be interesting to note how many orders are received as a result of the third post-war International Machine Tool Exhibition organised by the Machine Tool Trades Association at Olympia in June this year.

While both export and home demand are currently buoyant, an order book between fifteen months and two years long must result in further re-organisation and developments at home if these orders are to be satisfied and Britain is to hold its own in the export market. In 1955, while new orders expanded by as much as 20 per cent., deliveries based on the annual rate for the first nine months of the year, rose by only 6½ per cent. over 1954. Re-organisation takes time, however, and in 1955, was hampered by several factors, the most significant of which were large-scale shortages of materials and manpower.

SHORTAGES IN 1955

Most branches of the British engineering industry suffered from shortage of special steels during 1955, and heavy imports of expensive foreign steel offered little encouragement to an industry which was trying to keep down costs. Credit is in fact due to the machine tool industry for the way in which this has been achieved in the face of growing difficulties. The steel situation is expected to become less severe in 1956 as the credit squeeze reduces the consumption of steel by manufacturers of consumer goods, but supplies of certain types of high-tensile steel still cannot be obtained in under 2½ years, while the delivery date for alloy steels is being commonly quoted as at least 18 months. Spindle bearings cannot be delivered with certainty in less than a year.

Probably of more importance even than the steel problem, however, was the continuing shortage of labour which became more acute during 1955. The chairman of the Asquith Machine Tool Corporation Limited, at the annual general meeting in April, 1955, said that the only danger to a record year in 1955–56, would be a continued shrinkage of manpower. Wadkin Limited expected that the introduction of new types of machine tools might be held up by the same difficulty. The Scottish Machine Tool Corporation predicted that meeting intensifying competition in the export market will become even more difficult unless more skilled labour can be obtained. John Shaw and Sons Limited also reported that output was being checked by the "increasing shortage of labour, which is becoming a pressing problem." One answer to this problem would be an increase in the productivity of the existing labour force, and a comparison of machine tool deliveries and total labour force in the industry over the past two years suggests that more might be done in this direction.

However, the most pressing problem is the shortage of skilled labour; tooling-up for increased production is impossible if there is insufficient skilled labour to operate and maintain new machines. If the measures taken by the Chancellor of the Exchequer in October, 1955, are successful, however, 1956 may see some relief in this direction, since additional labour may become available as a result of reduction in the output of consumer goods.

EXPANSION AND DEVELOPMENT

In spite of labour difficulties investment has expanded in plant and equipment over the last year, and credit must go to individual companies in engendering such schemes in the face of many difficulties. It is interesting to note some of these plans in passing. In August last year Rolls-Royce Limited launched their new project for the Larkhall factory of the company, which is being reorganised to maintain and expand their production of precision machine tools. Kitchen and Wade Limited purchased additional property which will be developed as occasion demands, while the Sheffield Twist Drill and Steel Company, Limited, are erecting a factory at Worksop for the production of machine tools to meet the heavily increased demands of the aircraft and motor vehicle industries.

C.V.A. Jigs and Tools Limited brought into operation another new factory at the Hollingbury Industrial Estate. Kendall and Gent Limited are also providing additional floor space.

Also noteworthy has been the introduction of several new types of machine tools, despite the difficulties encountered throughout 1955. In addition to new developments in the wider field of automation, developments continued to be made in hydraulic operation. In 1955, the Rootes Group installed at Coventry a new horizontal hydraulic broaching machine manufactured at Tyburn by the Cincinnati Milling Machine Company, Limited. In April last year, Joshua Bigwood and Son, Limited, of Wolverhampton, announced the completion of a new 800 ton hydraulic plate stretcher. Said to be the largest in Europe, the machine incorporates an improved and patented type of grip head and modern hydraulic equipment; entry of plates into the grip is facilitated by a pre-flattening device. At about the same time Snow and Company, Limited, introduced a plano-type hydraulic surface and slideway grinder.

TABLE I.—*United Kingdom Exports of Metal-Working Machine Tools by Countries* 1953-1955

	Quantities (1,000 Cwt.)			Value (£1,000)		
	1953	1954	1955	1953	1954	1955
Union of South Africa	98	67	61	2,179	1,518	1,463
Rhodesia and Nyasaland	10	8	9	225	183	217
India	94	83	105	1,936	1,998	2,408
Pakistan	19	30	13	429	806	303
Australia	150	136	136	3,828	3,587	3,704
New Zealand	19	19	24	477	493	699
Canada	125	64	50	3,251	1,540	1,234
Other Commonwealth countries and Irish Republic	54	41	50	1,271	949	1,204
Soviet Union	19	13	41	211	259	619
Sweden	20	18	22	568	520	703
Norway	8	8	6	214	193	186
Denmark	9	6	7	187	198	213
Western Germany	12	6	27	594	267	424
Netherlands	16	18	35	475	478	593
Belgium	20	8	16	648	265	493
France	35	36	45	1,163	1,105	1,552
Switzerland	11	5	15	365	188	353
Spain	14	61	22	490	1,412	648
Italy	31	39	35	904	1,446	837
U.S.A.	61	35	31	1,626	944	914
Other foreign countries	88	78	77	2,186	1,888	2,148
	913	779	827	23,227	20,237	20,825

TABLE II.—*United Kingdom Exports of Metal-Working Machine Tools by Types* 1953-1955.

	Quantities (1,000 cwt.)			Value (£1,000)		
	1953	1954	1955	1953	1954	1955
Boring	40	37	41	1,166	1,053	1,021
Drilling	91	70	71	1,895	1,482	1,532
Grinding	71	61	75	2,228	1,932	2,449
Lathes:						
Automatic	50	37	35	2,135	1,508	1,520
Capstan and turret	61	49	55	2,185	1,815	2,074
Other	114	86	97	2,894	2,161	2,551
Screwing and threading	13	16	14	652	815	645
Milling and gear cutting	64	61	44	2,242	2,077	1,724
Planing, shaping and slotting	51	43	34	1,010	841	697
Presses:						
Hydraulic	45	35	59	725	671	994
Other	68	94	55	1,047	1,623	999
Punching and shearing	18	17	14	310	303	273
Others	125	93	113	2,588	2,216	2,310
Used, complete tools	34	36	71	417	320	433
Parts	68	44	49	1,733	1,420	1,603
Total	913	779	827	23,227	20,237	20,825

TABLE III.—*New Machine Tool Orders* (£ *millions*)

Quarters	Home	Export	Total
1952—			
First	11·1	6·4	17·5
Second	9·9	5·3	15·2
Third	7·6	3·6	11·2
Fourth	10·4	4·4	14·8
1953—			
First	9·5	3·0	12·5
Second	9·4	2·4	11·8
Third	8·8	2·9	11·7
Fourth	10·5	4·1	14·6
1954			
First	10·9	4·2	15·1
Second	12·4	5·3	17·7
Third	14·2	6·0	20·2
Fourth	20·3	5·2	25·8
1955—			
First	18·4	5·5	23·9
Second	20·2	5·5	25·7
Third	17·7	4·9	22·6

while Hugh Smith Limited last year produced a new type of plate-bending roller specifically designed for shipyard use, which incorporates hydraulic operation of the top roller instead of the conventional screws.

Other interesting new machines developed during 1955 included a new high-speed lathe developed by Hardinge Machine Tools Limited, which is intended to fill the gap between the plain precision bench lathe and the heavy duty engine lathe. Ransomes Sims and Jefferies Limited announced last August the development of the Diesel LSP lapping tool, which is claimed to give faster lapping and a better finish with equal accuracy. Wadkin Limited re-entered the field of non-ferrous metal-working machine tools as growing interest from the aircraft industry developed. Continuous development of new types of machine tools are essential if British manufacturers are to maintain and expand exports and reduce imports of machine tools.

CREDIT SQUEEZE AND THE FUTURE

What, then, taking all factors into account, is the outlook for the rest of 1956 ? In general, with an order book averaging 15 months, there would seem to be little likelihood of any immediate recession in output, though as stated in this series last year, there is always the possibility of cancellation of a proportion of the outstanding orders in the event of a general industrial recession. Labour and material difficulties may become less evident if the credit squeeze is successful in restricting the output of consumer goods. Looking at the longer term situation, however, any large-scale reduction in output by consumer goods industries is bound eventually to react on the demand for capital goods in the U.K. Last year provided a good example of what economists term the working of the accelerator principle—an increase in the demand for consumer goods generally leads to a more than proportionate increase in demand for capital goods and of machine tools in particular. Between June, 1954, and June, 1955, new orders from the home market for machine tools rose by over 60 per cent., although the index of industrial production rose by only 6½ per cent., and output of vehicles (which showed the greatest increase) expanded by 15 per cent.

Given an effective credit squeeze, however, this principle might well work in the opposite direction. A reduction in demand for consumer goods would then lead to a sharp decline in new orders for machine tools, as manufacturers work existing plant and machinery to full, or perhaps over-full, capacity and possibly beyond its normal economic life. Several warning signs were in evidence towards the end of 1955. Sales of electrical and gas domestic appliances have contracted sharply, while output of motor cars has been cut back rather more than is usual for the time of year. The influence of the credit squeeze should also gradually work through to the heavier industries as investment plans are modified due to shortage of capital. It is unlikely that the April Budget will contain any concessions in this field, in view of recent warnings by the Government. The conclusion appears to be that new domestic orders for machine tools will probably fall in 1956.

BALANCING MARKETS

The solution to declining orders from the home market is to make every effort to sell more overseas. In certain sections of the industry a decline in home orders might be welcome since it would help to shorten delivery dates. The outlook for exports generally is mixed. British export prices are on the whole competitive; German delivery dates are lengthening and there may be further trade liberalisation but, on the other hand, there is likely to be strong competition from foreign manufacturers, and the United Kingdom is not the only country in which anti-inflationary measures are required. A high proportion of overseas demand comprises the more complex, multi-purpose automatic machine tools, and this is particularly the case in the American market; new developments are also necessary if German competition is to be met.

The development of new and more productive equipment will also help to maintain replacement demand in the home market, which will become of increasing importance if there is a decline in the rate of expansion of engineering capacity. Owing to the long delivery on many types of machine tool, there is probably a substantial backlog in replacement demand, particularly since, owing to the labour shortage in the engineering industries generally, many machine tools have probably been worked more intensively than usual. This accumulated replacement demand may well go a long way towards preventing any serious fall in orders from the home market. Some indication of the importance of replacement demand was given last December in a survey of the machine tool industry made by the Noble Lowndes Finance Company, Limited. Quoting a report of the British Productivity Council, the survey estimated that the replacement market in the United Kingdom amounts to some 60,000 machines per annum, which must represent a high proportion of total home market sales.

While, therefore, machine tool manufacturers can look forward to the maintenance of a high level of output, there may well be some fall in investment demand. Any fall in new orders from the home market, however, should be kept within reasonable bounds owing to the accumulated replacement demand. The main problem facing the industry may well be that of continually rising costs and the difficulty of keeping prices down to levels which will be competitive in export markets.

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PERSONAL

MR. P. LEONARD GOULD, O.B.E., has retired from active participation in the affairs of the Joint Iron Council and the Council of Ironfoundry Associations.

MR. V. A. PASK, C.B.E., M.I.Mech.E., M.I.E.E., F.I.F., who retired recently from the position of chief engineer of the Central Electricity Authority, has joined John Brown and Co. Ltd., as consultant on power generation.

SIR WILLIAM ROOTES, G.B.E., has relinquished the chairmanship of Humber Ltd. and their subsidiary companies but will continue to serve on the board. The new chairman is SIR REGINALD ROOTES and MR. W. G. ROOTES, Sir William's eldest son now becomes deputy chairman. SIR WILLIAM ROOTES, SIR REGINALD ROOTES, MR. W. G. ROOTES and MR. B. G. ROOTES have joined the board of Singer Motors Ltd. Sir William becomes chairman and MR. A. E. HUNT, deputy chairman.

MR. L. BOMYER has relinquished the position of chief engineer to Ronald Trist & Co. Ltd., Bath-road, Slough, Buckinghamshire, but continues as director for technical matters and production. The new chief engineer is MR. R. G. ALLEN. MR. C. G. SCOLDING is appointed sales manager and MR. L. J. HEDGES, London manager, at 6-8 Upper Thames-street, E.C.4.

DR. E. A. WATSON, O.B.E., M.I.Mech.E., has been awarded the James Clayton Prize for 1955 of the Institution of Mechanical Engineers.

MR. C. L. G. WORN, B.Sc. (Eng.), A.M.I.Mech.E., has been made chief engineer, gas-turbine division, Brush Electrical Engineering Co. Ltd., Loughborough, in succession to Mr. R. C. MCLEOD, now engaged on technical design. MR. L. A. BENN, A.M.I.Mech.E., A.M.I.E.E., is promoted to chief engineer heavy electrical plant department, and MR. J. R. HUTCHINGS placed in charge of spares and repairs.

MR. W. E. SPARROW has retired from the managing directorship of Hardy Spicer Ltd., Salisbury Transmission Ltd. and Forgings & Presswork Ltd. MR. M. S. CROSTHWAITE has been appointed managing director of Harry Spicer Ltd., MR. K. W. EVANS, managing director of Forgings & Presswork Ltd., and MR. A. E. DEW and MR. A. PARRISH, general managers of Salisbury Transmission Ltd.

MR. R. CONNOR, O.B.E., A.M.I.E.E., has relinquished his directorships in Parkinson & Cowan Ltd. and various subsidiary companies and his chairmanships of the hydraulics and instruments divisions. SIR GEOFFREY VICKERS, V.C., has been elected a director of the firm.

DR. J. PEARSON, M.Sc., F.R.I.C., has been appointed assistant director of research, British Iron and Steel Research Association.

MR. D. N. RELF, M.B.E., A.M.I.E.E., has been appointed manager of transformer contracts, British Thomson-Houston Co., Ltd., Rugby, and MR. I. A. FERGUSON, M.I.E.E., manager of the mining department, in succession to MR. G. W. EDGLEY, who has relinquished both positions.

MR. V. H. TRIPP, B.Sc. (Eng.), M.I.C.E., has been appointed divisional engineer, South Eastern Division, British Transport Waterways, in succession to MR. C. A. WILSON, who is to retire on July 31.

MR. J. E. GREATOREX, M.I.H.V.E., A.M.I.F., informs us that he is now carrying on the practice as consulting heating and ventilating engineer, in succession to the late MR. H. Q. A. REEVES. The firm is styled J. E. Greatorex and Partners, 15 Berners-street, London, W.1 (Telephone: LANgham 1089 and 1080).

MR. H. W. HOOVER has become chairman of Hoover Ltd., Perivale, Greenford, Middlesex.

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COMMERCIAL

A new manufacturing company, WOLF ELECTRIC TOOLS (AUSTRALIA) PTY. LTD., has been formed and the directors are MR. D. K. NICHOLAS, MR. B. E. NICHOLAS and MR. R. A. G. HARDY, and also MR. H. RICHARDS and MR. G. M. WOLFE, who are directors of the parent firm, WOLF ELECTRIC TOOLS LTD., Pioneer Works, Hanger Lane, London, W.5.

V. L. FARTHING & CO. LTD. inform us that a completely separate company has now been formed under the name of ACOUSTOL OILS LTD., 327-329, Tower Building, Liverpool, 3.

ADDY PRODUCTS LTD. are shortly transferring their activities to the Industrial Trading Estate, Millbrook, Southampton.

SPENCER AND PARTNERS, 19 Grosvenor-place, London, S.W.1 (Telephone : SLOane 4884 and 2301), specialising in general corrosion prevention and particularly the design of cathodic protection installations, has been formed as independent consulting engineers by MR. K. A. SPENCER, B.Sc.Tech., M.I.Chem.E., F.I.M., taking into partnership MR. P. W. HESELGRAVE, B.Sc., D.I.C. DR. W. H. J. VERNON, O.B.E., F.I.M., F.R.I.C., is associated with the practice as co-consultant and adviser.

COSTAIN-JOHN BROWN LTD. have been appointed by the Government of India to advise them regarding the types of heavy-water plant which they should install to meet the forward commitments of their atomic-energy programme.

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CONTRACTS

Hydro-Electric Plant. The Punjab Government have ordered five vertical-shaft type water-turbine-driven a.c. generators for the first stage of the Bhakra Dam project on the Sutlej River, from the METROPOLITAN-VICKERS ELECTRICAL CO. LTD., Manchester, 17, through their associated company, ASSOCIATED ELECTRICAL INDUSTRIES (INDIA) LTD. The order is valued at over £1 million and each generator will have an output of 100,000 kVA at 166·7 r.p.m., the voltage being 11 kV three-phase 50 cycles and the power factor 0·9.

Electric Cable. A contract valued at 2 million dols. has been awarded to BRITISH INSULATED CALLENDER'S CABLES LTD. by the British Columbia Electric Co. Ltd., Vancouver. It is for the supply of 9·9 circuit miles of single-core 230 kV oil-filled cable. This will be laid in ducts and will transmit power from existing 230 kV overhead lines at Kidd substation, on the north arm of the Fraser River, to distribution points in Greater Vancouver.

Blast Furnace Installation. A complete blast-furnace installation is to be built by ASHMORE, BENSON, PEASE & CO., Parkfield Works, Stockton on-Tees, in conjunction with their South African Company, at the Pretoria Works of the South African Iron and Steel Industrial Corporation Ltd. The furnace will cost £1 million and have a hearth diameter of 25 ft. Its rated capacity is upwards of 1,000 tons of iron a day and it is intended to be ready for production early in 1958.

Turbo Alternators. An order for two 8,000 kW double pass-out condensing turbo-alternators has been received by the GENERAL ELECTRIC CO. LTD., Magnet House, Kingsway, London, W.C.2, from Simon-Carves Ltd. The installation of these sets in the carbonisation plant will form part of the modernisation scheme which the National Coal Board are effecting at Cwm Colliery, Wales.

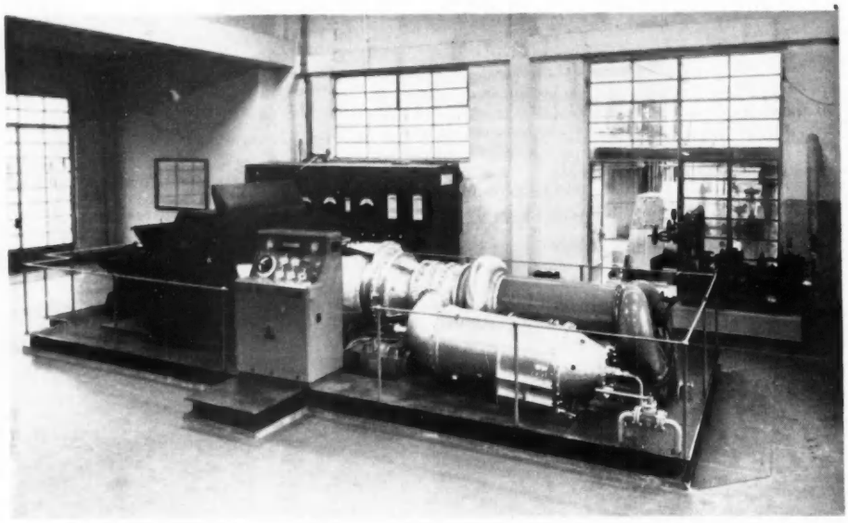

Fig. 1 At Cortemaggiore refinery, a 1,200 h.p. gas tubine has been installed; it will run on natural gas.

A GAS GAS-TURBINE

PLANT INSTALLED FOR RUNNING ON NATURAL METHANE

The discovery of natural gas, not only in the north of Italy, but in many other parts and even in Sicily, has changed the whole economic outlook of the country, which has little coal and limited hydro-electric power.

Some years before the war, seepage of natural gas through the rocks in a newly driven railway tunnel near the town of Bologna in Northern Italy caused considerable trouble. This was the first indication that there was natural gas in that area, and after the war serious drilling commenced in the Po Valley. At a depth of some 10,000 ft. near the village of Cortemaggiore, which lies not far from Piacenza, natural gas in enormous quantities was found. Wells there have a surface pressure of over 1,500 lb. per square inch and are piped to a distributing centre in Cortemaggiore where the heavier fractions are extracted for conversion to petrol, and where butane is filled into pressure vessels for domestic and other uses. The remaining gas, which is chiefly methane, is then distributed throughout the industrial north from Genoa to Venice, and from Bologna to Turin in large pipelines which to-day total nearly 2,000 miles in length and are constantly being extended. A description of them was given in ENGINEERING, vol. 180, page 700, 1955.

The development of this natural gas industry created a great potential field for the application of the industrial gas turbine, as natural gas is the ideal fuel for this prime mover. At this point, it should be explained that exploitation of natural gas in Northern Italy is government-controlled through the E.N.I. Group (Ente Nazionale Idrocarburi). The production is carried out by a subsidiary company, A.G.I.P. (Azienda Generale Italiana Petroli) Mineraria, while a second subsidiary, S.N.A.M. (Societe Nazionale Metanodotti) is responsible for marketing and distribution throughout the vast pipeline system.

Early in 1954, A.G.I.P. Mineraria were expanding their refinery at Cortemaggiore and were requiring additional power and steam supply. This called for power plant of high versatility in application and with ability to run for long periods with low maintenance. They decided that the "TA" gas turbine made by Ruston and Hornsby, Limited, Lincoln, was a suitable machine and in August, 1954, an order was placed for one of these standard units. This was the first industrial gas turbine to go into service in Italy. Following the receipt of the official order in August, the turbine was dispatched in the succeeding May. One month later, installation was complete, and on June 19, 1955, it was started up for the first time. The complete installation is shown in Fig. 1.

The Ruston "TA" gas turbine, which was fully described in ENGINEERING, vol. 175, page 321, 1953, is a simple open-cycle machine with free output shaft, and produces under normal conditions, when running non-recuperatively, an output of some 1,200 h.p. It is shown in cut-away form in Fig. 2. It has a 13 stage axial flow compressor, rotating at 11,500 r.p.m. on full load, which supplies compressed air to the combustion chamber and is directly coupled to a 2 stage compressor turbine. The hot gases from the compressor turbine are conveyed to the 2 stage power turbine which rotates at 6,000 r.p.m. and is coupled through an epicyclic reduction gear to the generator which is a 500 volt 50 cycle, 3 phase machine, designed and made by the Campagnia Generale per Elettricita of Italy. Cooling of the turbine is effected entirely by air bled from the axial compressor and ducted to all necessary points. Prior to the installation of the gas turbine, four Worthington 350 kW gas engines had supplied the power at Cortemaggiore refinery and the Ruston turbine, which now takes the main load, is running in parallel with these engines.

In addition to supplying power, the gas turbine has been fitted with an exhaust heat boiler with an economiser which provides process steam for the refinery. The rating of the gas-turbine alternator set with the exhaust heat boiler by-passed is 890 kW; this is reduced to 870 kW when the exhaust gases pass through the boiler, because of the back pressure of 80 mm. water gauge imposed on the gas turbine.

The boiler equipment, which was manufactured and designed in Italy, comprises a Tosi boiler incorporating "Swirlyflow" tubes, a superheater and a Green-type economiser. When operating on turbine exhaust, this installation can produce 4,200 kg. of steam per hour at a working pressure of 8 kg. per sq. cm. By utilising the considerable quantity of oxygen present in the exhaust, auxiliary gas burners can be used to increase the total steam output to 9,000 kg. per hour. The burners installed are of sufficient capacity to ensure that, even when the turbine is not running, the full steam output of 9,000 kg. per hour can be obtained. In the latter case a separate auxiliary air supply is fed to the methane burners in the boiler.

The flexibility of the gas turbine and boiler system is further increased by the ducting arrangement which allows the turbine to exhaust direct to atmosphere without the gases passing through the boiler; alternatively, the boiler can be isolated from the turbine and be operated as an independent unit. In the power house the ducting for the air intake and the gas exhaust of the turbine is placed beneath floor level. The lubricating oil for the gas turbine is cooled in a compact water-type cooler mounted alongside the set.

To avoid the necessity of shipping the Italian-manufactured alternator to Lincoln, the turbine output shaft, together with coupling bolts, was sent to Italy in advance in order that it could be bolted to the alternator rotor at the manufacturers' works and the complete shaft system accurately balanced.

Starting the gas turbine, and control when running, is carried out from a control cubicle mounted alongside the turbine and carrying all necessary pressure and temperature instruments. The starting procedure is safeguarded by interlocks incorporated in the control panel, in such a way as to ensure that the various starting processes are carried out in the correct time

Fig. 2 Cut-away view of the complete gas turbine set.

intervals. To facilitate frequency adjustments, a remote control speed regulator is fitted on the main alternator control panel. The starting of the set is by means of a 20 h.p. electric motor operating on the end of the compressor shaft. The motor is powered by a 24 volt battery of conventional design.

The Ruston set went into operation simultaneously with the new oil refinery plant, and therefore it was some time before any sort of steady load was obtainable. As a result of this, it was decided to carry out full performance tests on site with water-resistance load tanks, and it was in this way that the turbine was passed and accepted by customers.

Since no methane gas in any quantity is available in England, the comprehensive works tests could not include continuous running on the actual type of fuel available on site. The Italian installation provided the first opportunity to run the gas turbine on continuous service when using natural gas fuel, and the experience obtained during early site tests resulted in minor modifications to combustion chamber settings and burner. In addition, it was found necessary to effect small adjustments to the exhaust ducting. This work was soon accomplished and the plant was put into regular operation.

Up to the end of 1955, the set had run for over 3,000 hours on service loads, mostly in parallel with one or more of the piston gas engines. Now that the refinery plant has settled down it is intended to run the turbine continuously day and night seven days a week until plant overhaul sometime in April, 1956.

A second Ruston Mark "TA" gas turbine alternator set has been installed in Italy, at the headquarters of S.N.A.M. in San Donato. This set is now providing power and light to workshops, gas compressor bottling plant, etc., and also heat and light to a variety of buildings, including an hotel, apartment houses and private dwellings for S.N.A.M. employees, which cover some 150 acres—a community known as Metanopoli, San Donato, Milan. The increasing exploitation of natural gas is widening the field of application for the industrial gas turbine in many parts of the world.

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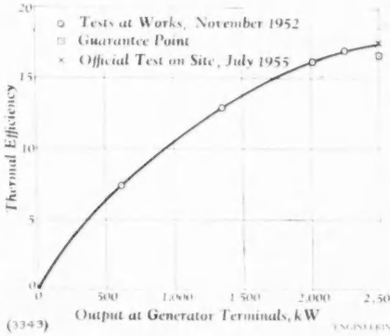
GAS-TURBINE TRIALS

Acceptance Test on 2,500 kW set

The results of the acceptance trials carried out on the Metropolitan-Vickers gas-turbine generating set at the Ashford Common Pumping Station, have recently been made known. This set is one of three (of different makes) that are installed at the station to act as stand-by plant. A full description of the station and plant was given in ENGINEERING, vol. 179, page 740 (1955).



Thermal efficiency curve for 2,500 kW gas-turbine generator set, based on lower calorific value of the Diesel oil used.

The Metropolitan-Vickers set is rated at 2,500 kW at 7,000 r.p.m. It is a single-shaft open-cycle unit, working without a heat exchanger and burning distillate fuel oil. The acceptance test consisted of a 6 hour run at full load, the load being maintained almost constant by use of a load tank. The two-wattmeter method of measurement was employed and the fuel used was weighed; it had a lower calorific value of 18,305 B.Th.U. per lb. When corrected for atmospheric conditions, the heat consumption of the set was 19,345 B.Th.U. per kWh, 5·17 per cent. better than the guaranteed figure. The maximum exhaust temperature recorded was 725 deg. F., well below the contract figure of 795 deg. F. An efficiency curve combining the works and acceptance tests is given in the diagram.

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STEEL FRAME CASTING OF 142 TONS

For Lackenby Rolling Mill

A heavy and complicated steel casting measuring some 26 ft. in length, 12 ft. in width and 8 ft. in depth has been delivered by English Steel Castings Corporation Limited, Sheffield, a subsidiary company of English Steel Corporation Limited, to the Darnall works of the Davy and United Engineering Company Limited, Sheffield. It is a 142 ton "C"-frame casting for a 1,350 ton shear which the Davy and United Company are building for Dorman, Long and Company, Limited, as part of a contract for a new blooming and slabbing rolling-mill plant at Lackenby, near Middlesbrough.

Despite the many technical problems presented by varying wall thicknesses and shapes, it was decided by the two firms that a casting made in one piece was the only possible method of manufacture. Neither a fabricated structure nor two or three separate castings could be designed which would have met the arduous service requirements of a shear.

The mould with its intricate arrangement of 80 cores was made in a pit, 35 ft. in length, 17 ft. in width and 10 ft. in depth, at the Grimesthorpe steel foundry of the firm. This is shown below on the left. Some 1,240 man-hours were accounted for in moulding and closing, and 600 in core making and fitting. It took a further four weeks to dry out the mould by means of portable coke-fired drying stoves.

The casting operation occupied 30 minutes during which three ladles simultaneously poured a total of 198 tons of molten steel into the mould. Subsequently, over a period of several hours, a further 25 tons of liquid steel were added to the 21 feeder heads of the mould. For the pouring operation, practically the whole of the foundry's steelmaking resources were required and for the bulk of the steel, three open-hearth furnaces had to be tapped simultaneously.

The casting was left in the mould for four weeks to cool, after which hydraulic jacks and electric overhead travelling cranes were employed to lift it from the pit before conducting the fettling and heat-treatment operations. The finished casting is seen in the illustration below, on the right.

A further casting of similar design is to be supplied to the Davy and United Engineering Company, later this year.

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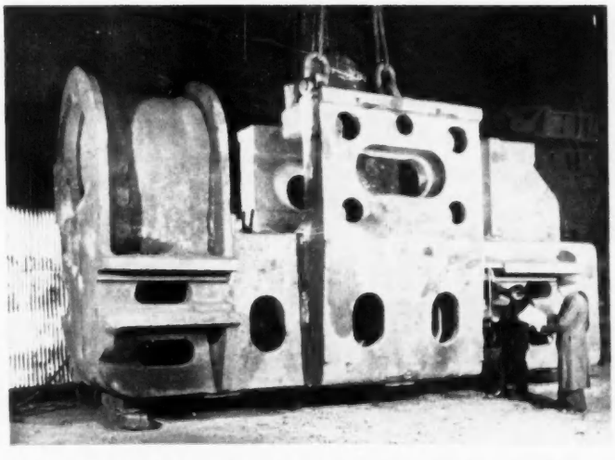
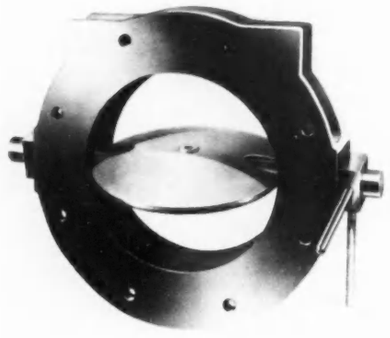
GAS MAIN THROUGH MERSEY TUNNEL

To integrate the gas distribution schemes on both sides of the River Mersey, the North Western Gas Board, Liverpool, and Wirral Group, have recently installed an 18 in. diameter higher-pressure gas main through the lower half of the Mersey Tunnel. The main contractor was William Press and Son, Limited, 22 Queen Anne's Gate, London, S.W.1; and Welding Supervision Limited, 8 The Sanctuary, London, S.W.1, were responsible for the radiographic control and classification of welding, and for the maintenance of high standards. This entailed the construction in the tunnel of a prefabricated radiographic laboratory, which was moved along as the work proceeded. Radioactive isotopes were used extensively, and it was necessary to solve such problems as welding under excessive draught and the examination of welds in positions where access was difficult.



On the left: **Mould for 142 ton shear frame casting in pit 35 ft. long, by 17 ft. wide, by 10 ft. deep at E. S. C. Corporation's foundry. Eighty cores are involved.** *On the right:* **Finished casting, which is to form part of a blooming and slabbing rolling-mill plant being built by Davy United for Dorman, Long and Co., for installation at Lackenby.**



By making the rotating member of a butterfly valve from two flexible discs fitted so that the line of contact passes through the centre of rotation, a good seal is obtained.

BUTTERFLY VALVES

Models with Very Low Leakage

The butterfly or pivoted disc valve is essentially a control unit with the main attribute of quick operation. It is of simple construction and accordingly has wide application in many branches of engineering. It is not however an efficient stop valve notwithstanding the many attempts to render it so. In spite of the most careful hand fitting techniques, high leakage rates have hitherto ruled out the butterfly valve in favour of the bulkier and more costly gate valve. On the other hand it is a well known fact that the various forms and makes of gate valve are not immune from leakage, particularly in the larger bore sizes. Furthermore the mechanical load applied to the valve seat, calculated on area times pressure, can be, and often is, of an extreme order. It is not surprising therefore to find that the sealing surfaces deteriorate rapidly when subjected to high sliding loads. It is interesting to reflect that in the case of the butterfly valve such loads are carried directly on the two spindle bearings and not at the periphery of the disc; no doubt it is this fundamental feature of design which has prompted so many efforts to make the butterfly valve seal effectively in the casing bore.

It is becoming increasingly apparent to those engaged on current valve design that the earlier techniques of employing a rigid valve member in conjunction with a rigid valve seat certainly do not provide the desired result (regardless of hand fitting, etc.) under variation of pressure and temperature. It has been established conclusively that if one of the mating members is permitted to flex (within the elastic limit of the material) a more positive fluid seal is possible.

In light of the data obtained in developing the large diameter "Tansphere" valves up to 60 in. in diameter, Swain Projects, 5a Kirloe-avenue, Kirby Muxlow, Leicester, felt that butterfly valves ranging up to that diameter could be produced with a "leakage area" certainly not greater than that often tolerated in the orthodox gate valves. In all known forms of butterfly valves, the rocking valve member is normally bossed to carry a spindle, the axis of which intersects the peripheral seal. In short the circular seal is broken at two diametrically opposed points to accommodate the spindle diameter.

In the attempt to improve the sealing characteristics it became apparent that an unbroken circular seal must be maintained between the mating parts, and this was achieved in the following manner. The valve member is built up from two flexible spherically dished discs assembled each side of a centrally disposed spindle. The partially machined spindle was first made fast in the casing to permit final machining. The unbroken sealing surface was obtained by machining the bore of the casing (integral with spindle) so that half of the spindle was also cut away locally to form a flat face against which one of the discs could sit. In the same machine setting, the centre of the spindle was bored and screwed to receive two opposed countersunk screws.

The two discs, each provided with a centrally disposed countersunk hole, were then machined on diameter to be freely mounted in the casing bore. The disc on the recessed side of the spindle is complete, while that on the other side is cut away to fit flush with the first. It will be understood that on tightening the two screws alternately, the disc assembly can be pre-stressed progressively (beyond actual rating conditions) and finally flexed sufficiently to form a continuous seal in the casing bore equivalent in tightness to a "light drive fit." As long as the circumferential seal passes through the true spindle axis, the discs may be rotated about that axis.

Whereas in theory only "line contact" is possible between the one rocking disc and casing bore, in actual practice appreciable surface contact prevails due to flexing of the disc. For example the width of seal in a 9 in. bore valve is approximately $\frac{1}{32}$ in.

The advantages attached to this construction are: relatively light, simple and easy production; the mechanical load is carried on suitable bearings and not on critical valve seat; the mechanical load imposed on sealing surface is pre-determined and is not a function of fluid pressure; the valve may be adjusted (in pipe line) to give any desired degree of seal to the extent of a "drive fit"; large diameter valves up to 60 in. bore may be hand controlled by capstan through the medium of a reduction gearbox applied to the end of the spindle.

The prototype unit as shown in the illustration, manufactured by David F. Wiseman and Sons, Limited, 145 Conybere-street, Birmingham, 12, proved to be very satisfactory and gave results comparable with the normal forms of stop valves. Experiments are in hand to determine whether, by lapping techniques, it is possible somewhere to approach the very high degree of seal obtained with the large diameter Tansphere valves. Although the unit has been developed primarily to handle air and carbon dioxide it is clearly suitable for large water valves, oil lines, etc.

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DEAD TANK OIL CIRCUIT-BREAKER

5,000 MVA : 132 kV

The accompanying illustration shows a dead tank oil circuit-breaker, which has recently been designed by Messrs. Ferguson Pailin, Limited, Higher Openshaw, Manchester, 11, for use on extra-high-voltage systems. It is capable of interrupting and making fault currents equivalent to 5,000 MVA at 132 kV on a 50 cycle three-phase circuit and is suitable for load currents up to 1,200 amperes. It complies with the relevant clauses of British Standard Specification No. 116 (1952) and also with the General Electricity Authority's specification for this class of equipment. It has been designed to operate satisfactorily under extreme climatic conditions.

CONSTRUCTIONAL DETAILS

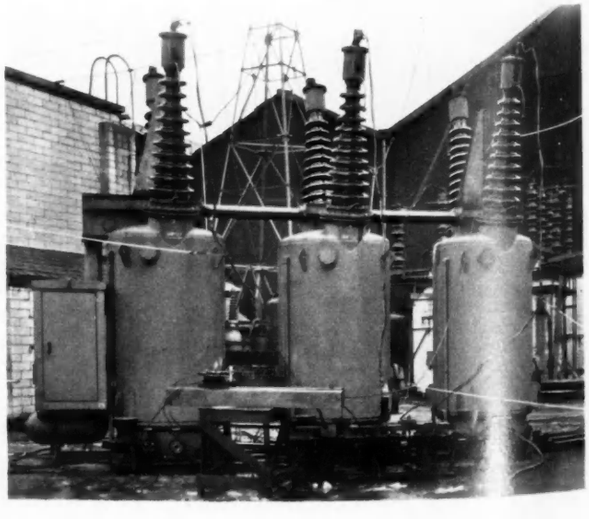
As regards construction, the circuit-breaker, as will be seen, consists of three separate single-phase units, the mechanisms of which are linked externally through light-alloy drives to a common operating mechanism. This mechanism is housed in a weather-proof kiosk, which also contains the local control apparatus. The closing mechanism, which is trip free throughout the closing stroke, can be operated either by solenoid or pneumatically.

The self-contained terminal bushing insulators are of the oil-filled barrier type and are independently removable. Adjustable arcing horns are fitted to each bushing at the lower ends of which is space for a current transformer which is mounted in a turret. The fixed contact assemblies are of the three-segment high-pressure spring-loaded lever butt type and incorporate a wiping action at the point of engagement with the tubular moving contacts. These latter contacts are mounted on light-alloy carrier bars which in turn are carried on insulating lifting bars. The lifting bars are connected to the external operating mechanism through links and shock absorbers.

ARC CONTROL

The circuit-breaker is equipped with self-compensated cross-fit arc control devices, the duty of current interruption being shared between two breaks by using non-inductive shunt reactors, which also limit the transient overvoltages during switching. During the opening stroke the moving contacts are accelerated by springs of the torsion-bar type which in combination with the lightness of the moving parts and the use of short travel butt contacts ensure that the total break time does not exceed 3 cycles.

We understand that the performance of the new circuit-breaker has been proved by tests at the Manchester station of the Switchgear Testing Company, where tests were also made to confirm its suitability for switching the capacitive and inductive currents associated with line charging and transformer switching.



Dead tank oil circuit-breaker designed by Ferguson Pailin, Ltd., for interrupting and making fault currents up to 5,000 MVA at 132 kV.

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NEW CHAIR IN MARINE ENGINEERING

A gift of £35,000 contributed by firms on the North-East Coast for the endowment of a new Chair in Marine Engineering has been accepted with gratitude by the Council of University of Durham, King's College, Newcastle-upon-Tyne.

In Parliament

ATOMIC ENERGY

Questions recently asked in the House of Commons have included a number on various aspects of atomic energy. Mr. R. Moss (Labour) desired to know what proportion of expenditure upon nuclear research and development was devoted to peaceful and civil purposes, and was informed by Mr. R. A. Butler, the Lord Privy Seal, that much of such expenditure was likely to help forward both the peaceful and military applications of atomic energy. It was, therefore, not possible to estimate the proportion requested.

In answer to questions by Mr. G. Nabarro (Conservative) regarding progress at atomic power stations, Mr. Butler said that H.M. The Queen would switch into the national grid the current generated by the first of the two reactors at Calder Hall power station on October 17 next. The second reactor was expected to be brought into operation within six months of that ceremony. As to the sites and capacities of other atomic power stations, Mr. Butler stated that the responsibility for the stations to be constructed under the Government's civil power-production programme, announced in their White Paper of a year ago, rested with the Minister of Fuel and Power and the electricity authorities. The six additional reactors of the Calder Hall type to be erected by the Atomic Energy Authority would have a total capacity of about 200 MW and would probably come into operation in 1959 or 1960. Two would be built at Calder Hall and four near Annan in Dumfriesshire.

Mr. Butler told Mr. J. Taylor (Labour) that he was unable to authorise an investigation into the shale deposits in West Lothian as a possible source of fissionable material for nuclear fuel. The shale deposits there had a very low uranium content, amounting to less than 20 parts per million, and no process for extracting such small quantities at an economic cost was at present known.

SITES FOR NEW STATIONS

In a written answer, Mr. David L.-M. Renton, Parliamentary Secretary to the Ministry of Fuel and Power, told Mr. Nabarro that in deciding upon sites for atomic power stations, as distinct from other power stations, it could be assumed that fuel costs would not be affected by the location of the site chosen. Foundations and water-cooling arrangements were, accordingly, the principal requirements to be considered. It had been decided to construct the first atomic power stations away from built-up areas as an additional safety precaution. There would be no radioactive effluent, as spent fuel from the reactors would be returned to the Atomic Energy Authority's factories for further treatment.

National Physical Laboratory Directorship

Mr. John Hall (Conservative) was informed by Mr. J. R. Bevins, Parliamentary Secretary to the Ministry of Works, that Sir Edward Bullard, F.R.S., vacated the directorship of the National Physical Laboratory on December 31 last, and that Dr. R. L. Smith-Rose, C.B.E., was appointed acting director as from January 1, 1956. He would serve in that capacity until Sir Edward's successor had taken up his appointment. It was expected that an announcement of the new director would be made in a matter of weeks. The salary was £3,250 per annum.

Civil Use of Aden Airfield

The use to which the airfield at Aden might be put as a link in the chain of civil aviation communications in the British Commonwealth was the subject of questions by Mr. Paul Williams (Conservative). He was informed by Mr. Nigel Birch, the Secretary of State for Air, that British Overseas Airways Corporation, Air India International, and Aden Airways already used the airfield. It was capable of being used by Britannia aircraft. Mr. Harold Watkinson, the Minister of Transport and Civil Aviation, said that Aden was being utilised for civil aviation purposes to the extent justified by its geographical position and present traffic requirements. Its future possibilities would be kept under review.

Feltham Ship-Testing Tank

Answering Mr. F. T. Willey (Labour), who desired information about progress in the building of a new ship-testing tank at Feltham, Mr. Bevins said that work was begun in March, 1955, and was progressing according to schedule. The concreting of the main tank was about half finished. The construction of the workshops and offices was also proceeding normally.

Stevenage Fuel Research Station

Also in answer to Mr. Willey, who asked about the provision of a new fuel research station for the Department of Scientific and Industrial Research, Mr. Bevins said that a site for such a station had been selected at Stevenage. Work would probably be begun in 1957.

NOTICES OF MEETINGS

Aslib

LONDON
"Sources of Information in the History of Science," by Dr. D. McKie. Royal Society of Arts, John Adam-street, W.C.2. Wed., Feb. 15, 6 p.m.*

Association of Supervising Electrical Engineers

LONDON
"Underground Railways Electrical Practice," by R. H. Rintall. Central London Branch. St. Ermins Hotel, Caxton-street, S.W.1. Mon., Feb. 13, 7 p.m.
BOURNEMOUTH
"Installation and Operation of a Television Station," by E. P. B. Metcalfe. Bournemouth Branch. Grand Hotel, Firvale-road, Bournemouth. Tues., Feb. 14, 8 p.m.
LUTON
"Automatic Temperature Control," by S. O. Grant. Luton Branch. Midland Hotel, Williamson-street, Luton. Tues., Feb. 14, 8 p.m.
WATFORD
"Electricity in the Marine Industry," by J. Bushby. Watford Branch. Clarendon Hotel, Station-road, Watford, Herts. Thurs., Feb. 16, 8.15 p.m.

Building Centre

LONDON
Films on jointing and fitting copper pipe. 26 Store-street, W.C.1. Wed., Feb. 15, 12.45 p.m.

Chemical Engineering Group

LONDON
"Manufacture of Phosphorus," by F. B. Shepherd. Geological Society, Burlington House, Piccadilly, W.1. Tues., Feb. 14, 5.30 p.m.

Chemical Society

LONDON
Various papers for discussion. Burlington House, Piccadilly, W.1. Thurs., Feb. 16, 7.30 p.m.
BRISTOL
"Research in the Glass Industry." Bristol Branch. Chemistry Department, The University, Bristol. Thurs., Feb. 16, 5.15 p.m.

Diesel Engineers and Users Association

LONDON
"Cast Irons for Diesel Engines," by Dr.-Ing. J. G. Pearce. Caxton Hall, Victoria-street, S.W.1. Thurs., Feb. 16, 2.30 p.m.

Illuminating Engineering Society

HULL
"Cold Cathode Lighting," by G. Robinson and A. E. Fothergill. Offices of the Yorkshire Electricity Board, Ferensway, Hull. Mon., Feb. 13, 7 p.m.
MANCHESTER
"Recent Work on Discomfort Glare," by R. G. Hopkinson and P. Petherbridge. Manchester Centre. Offices of the North Western Electricity Board, Town Hall Extension, Manchester. Thurs., Feb. 16, 6 p.m.
SHEFFIELD
"Photometric and Other Tests for Street Lighting," by W. A. Varney. Sheffield Centre. Medical Library, The University, Western Bank, Sheffield 10. Mon., Feb. 13, 6.30 p.m.

Incorporated Plant Engineers

BLACKBURN
"Current Lubricants and Their Significance to Plant Engineers," by J. Chisholm. Blackburn Branch. Golden Lion Hotel, Blackburn. Thurs., Feb. 16, 7.30 p.m.
DUNDEE
"Lifting Gear," by J. W. Steele. Dundee Branch. Mathers Hotel, Dundee. Mon., Feb. 13, 7.30 p.m.
LIVERPOOL
"Steam Turbines in Plant Engineering," by Professor W. J. Kearton. Merseyside and North Wales Branch. Royal Institution, Colquitt-street, Liverpool. Thurs., Feb. 16, 7.15 p.m.
ROCHESTER
"Diesel Engine Development," by R. W. Stuart Mitchell. Kent Branch. Bull Hotel, Rochester. Wed., Feb. 15, 7 p.m.

Institute of British Foundrymen

BRISTOL
"Light-Alloy Practice," by C. J. Williams. Bristol and West of England Branch. Grand Hotel, Bristol. Sat., Feb. 18, 3 p.m.
LEICESTER
"Two Water-Cooled Cupolas," by D. W. Berridge and J. R. Hawley. East Midlands Branch. College of Technology and Commerce, Leicester. Sat., Feb. 18, 6 p.m.

Institute of Fuel

LONDON
"Fuel Conditions in New Zealand, with Special Reference to the Coal Industry," by Prof. J. I. Graham. Institution of Civil Engineers, Great George-street, S.W.1. Wed., Feb. 15, 5.30 p.m.*
SHEFFIELD
"Solid-Fuel-Burning Gas Turbines," by J. D. Thorn. Yorkshire Section. Royal Victoria Hotel, Sheffield. Wed., Feb. 15, 2.30 p.m.

Institute of Marine Engineers

LONDON
"Wear in Marine Gearing," by Dr. W. H. Darlington; and "Teething Troubles in Post-War Reduction Gears," by S. Archer. 85 Minories, E.C.3. Tues, Feb. 14, 5.30 p.m.*

Institute of Road Transport Engineers

LONDON
"The Training of Drivers for Commercial and Public-Service Vehicles," by Major-General B. K. Young. Royal Society of Arts, John Adam-street, W.C.2. Thurs., Feb. 16, 6.30 p.m.*
GLASGOW
"The Development of the Lightweight Oil Engine," by H. L. Parrish. Scottish Centre. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank-crescent, Glasgow, C.2. Mon., Feb. 13, 7.30 p.m.

Institute of Welding

SLOUGH
"The Part of Resistance Welding in Automation," by R. W. Ayers. Slough Section. Community Centre, Farnham-road, Slough Bucks. Tues., Feb. 14, 7.30 p.m.*

Institution of Civil Engineers

LONDON
"The Design and Construction of Aden Oil Harbour," by J. E. G. Palmer and Harold Scrutton. Great George-street, S.W.1. Tues., Feb. 14, 5.30 p.m.*
LIVERPOOL
"Diving Equipment: Its Development and Uses in Civil-Engineering Work," by I. E. Fraser. North Western Association. 9 The Temple, 24 Dale-street, Liverpool. Wed., Feb. 15, 6 p.m.

Institution of Electrical Engineers

LONDON
Discussion on "Power Supplies to Electrical Laboratories," to be opened by Dr. P. F. Soper. Education Discussion Circle. Savoy-place, Victoria-embankment, W.C.2. Mon., Feb. 13, 6 p.m.*
"An On-Off Servomechanism with Predicted Changeover," by J. F. Coales and A. R. M. Noton. Measurement and Control Section. Savoy-place, W.C.2. Tues., Feb. , 5.30 p.m.*
Faraday Lecture on "Coal Mining Electrically," by B. L. Metcalf. Central Hall, Westminster, S.W.1. Wed., Feb. 15 6 p.m. (Admission by ticket.)
Papers on "The 3 : 1 Pole-Changing Induction Motor." Utilization Section. Savoy-place, W.C.2. Thurs., Feb. 6, 5.30 p.m.*
NEWCASTLE-UPON-TYNE
Chairman's Address on "Opportunities, Responsibilities and Recruitment of Professional Electrical Engineers in Industries other than the Electrical Industry," by D. B. Hogg. North Eastern Centre. Neville Hall, Westgate-road, Newcastle-upon-Tyne. Mon., Feb. 13, 6.15 p.m.

Institution of Engineers and Shipbuilders in Scotland

GLASGOW
"Modern Metal Cutting," by G. V. Stabler. 39 Elmbank-crescent, Glasgow, C.2. Tues., Feb. 14, 6.30 p.m.

Institution of Mechanical Engineers

LONDON
"M.I.R.A. Proving Ground," by Dr. A. Fogg. Automobile Division. 1 Birdcage-walk, St. James's Park, S.W.1. Tues., Feb. 14, 5.30 p.m.*
Discussion on "Technical Authorship and Illustration." Education Group. 1 Birdcage-walk, S.W.1. Thurs., Feb. 16, 6.45 p.m.*
"Testing of Boilers and Turbo-Alternators in Power Stations," by H. S. Horsman. Steam Group. 1 Birdcage-walk, S.W.1. Fri., Feb. 17, 5.30 p.m.*
PORTSMOUTH
"Gas Turbines for Marine Uses," by Lieut.-Commander A. Stewart. Southern Branch. College of Technology, Anglesea-road, Portsmouth. Wed., Feb. 15, 7 p.m.
SWANSEA
"Instrumentation for the Process Industries," by B. W. Balls. South Wales Branch. Mackworth Hotel, Swansea. Tues., Feb. 14, 6 p.m.

Institution of Mining and Metallurgy

LONDON
Various short papers. Geological Society, Burlington House, Piccadilly, W.1. Thurs., Feb. 16, 5 p.m.*

Institution of Production Engineers

LONDON
"Milling versus Broaching," by A. R. Hambidge. Royal Empire Society, Craven-street entrance, W.C.2. Thurs., Feb. 16, 7 p.m.
OXFORD
"Hydraulic Mechanisms for Automatic Processes," by I. McNeill. Oxford Section. Town Hall, Oxford. Tues., Feb. 14, 7.15 p.m.

Institution of Public Health Engineers

LONDON
"Modern Applications of Ion Exchange," by B. A. Sard. Caxton Hall, Westminster, S.W.1. Thurs., Feb. 16, 6 p.m.

Institution of Railway Signal Engineers

LONDON
"Cabling in the Severn Tunnel," by P. Jacobs. Institution of Electrical Engineers, Savoy-place, Victoria-embankment, W.C.2. Wed., Feb. 15, 6 p.m.*

Junior Institution of Engineers

LONDON
"The Engineer Goes Sailing," by N. J. Bowyer Lowe. Pepys House, 14 Rochester-row, S.W.1. Fri., Feb. 17, 7 p.m.*

Manchester Association of Engineers

MANCHESTER
"Diesels," by C. J. Hind. Engineers' Club, Albert-square, Manchester. Fri., Feb. 17, 6.45 p.m.

Reinforced Concrete Association

LONDON
"Recent Research on the Vibration of Concrete," by Dr. J. M. Plowman. 11 Upper Belgrave-street, S.W.1. Wed., Feb. 15, 6 p.m.*

Royal Statistical Society

LONDON
"Analysis of Business Concentration," by P. E. Hart and Dr. S. J. Prais. London School of Hygiene and Tropical Medicine, Keppel-street, W.C.1. Wed., Feb. 15, 5.15 p.m.*

* An asterisk is placed where it is understood that tea is available prior to the time stated.

THE HUMAN ELEMENT

Freedom in spending—Wage differentials are causing trouble—Training the young worker—A sad story of Birmingham and Lyons.

★ ★ ★

Welfare and Wages

A report recently published by the European Coal and Steel Community throws light on the part played by employers' supplementary payments for welfare services. In the member countries—France, Germany, Belgium, Holland, Italy, Luxembourg and the Saar—employers pay, in addition to wages, obligatory contributions for social services, pensions, holidays, subsidised housing, free coal, etc., which amount to a major proportion of the industries' wage bills. In France and Germany, for example, such payments amount respectively to 65·5 and 48·5 per cent. of wages in steel, 78·6 and 61·7 per cent. in coal.

No corresponding figures exist in this country, where the proportion is almost certainly substantially lower. Yet it has been rising rapidly in the past few years and may now amount to some 15 per cent. of average earnings (if benefits under the Health Service and housing subsidies are taken into account). Paid holidays are probably the largest item, amounting to some 5 or 6 per cent. of the wage bill, and there are a large number of voluntary contributions, such as pensions, health and recreation facilities, canteens and profit sharing. Competition for labour has caused a major increase in such voluntary payments since the war.

In the United States there has been a similar growth in what the American Bureau of American Statistics describe as " fringe earnings." Work has recently been started to measure them. It would be of considerable interest to have the same type of research done here, even if only on a sample basis. It is yet another " leveller " between skilled and unskilled, and a trend of considerable importance to the trade union movement. There is a strong argument in favour of the individual being allowed to spend —or save—as he chooses rather than have free services foisted upon him.

★ ★ ★

Dangerous Wrangles

The recent wave of " stubborn " strikes suggests that fresh thinking is urgently required within the trade union movement and among employers on the contentious subjects of differentials and demarcation. To these two one could add bonus rates. The earnings of Mr. McLennon at the Glasgow factory of Rolls-Royce were far enough above " normal " to imply either utterly unrealistic times or the near-complete failure of piece rates as a general incentive to higher output.

Differentials led to the major strikes on the railways last year and are now one of the root causes of the printing dispute. It is the main factor in the teachers' revolt against their conditions of employment and the low salaries they receive. Everywhere the question of a fair reward for skill—generally acquired over a long period of training and, one suspects, not always by the quickest methods—is splitting the trade union movement and losing the country millions of pounds. Granted that a national wages policy is a negation of the *raison d'être* of the unions, this does not preclude a wage policy for an industry, or a rational arrangement within the movement. The cost of training can be measured, the " responsibility content " of various types of work can be fairly assessed, as can the " profitability " of various operations. The enemy of a common sense approach is bargaining strength, and out-of-date methods of remuneration. To persist in the present follies can bring to the country a shortage of skill—when a new industrial revolution is placing a large premium on it—which could be fatal.

★ ★ ★

Attractions and Distractions

Among boys between the ages of fifteen and seventeen, not more than one in three goes through any form of apprenticeship or its equivalent with a view to taking up a technical or professional career. Such were the findings of the working party set up by the King George's Jubilee Trust in 1955. At its last meeting, the National Joint Advisory Council decided to undertake an inquiry into schemes for training the young worker in industry.

The time is ripe. In a few years the increased birth rate after the last war will be producing a temporary increase in young people coming into the labour market. Full use must be made of this passing bulge for it is not likely to appear again under present economic and social conditions as far as one can see. In fairness to the engineering industry in particular, it has to be said that there is more attendance at classes during the company's time than there ever was before the war, but that does not solve the problem of the large numbers of youngsters going into dead-end jobs. Full employment, inadequate differentials between skilled and unskilled rates on the job and national service are all blamed for the dearth of willing recruits for technical training. It is an encouraging sign that a body as influential as the N.J.A.C. is to sponsor such a study. It should be a really comprehensive study. The investigators are likely to find that the problem is not only to get young men to undertake courses but also to complete them in an age when has plenty of distractions apart from high earnings.

★ ★ ★

Tout ou Rien

The difficulties experienced by the civic authorities of Birmingham and Lyons are striking evidence of the deep political cleavages in the French trade union movement. The veteran Mayor of Lyons, M. Herriot, initiated in 1951 a series of regular exchanges of visitors between the two cities. Last year, Mr. George Varnom, president of the Birmingham Trades Council, met his trade union opposite numbers in Lyons and suggested exchange visits between them. But there are three main groups of French trade unions—the C.G.T., the Force Ouvrière and the Christian unions—and no agreement between them seems possible for the dispatch of a representative delegation. For their part the Birmingham Trades Council wish to receive all three or none, and there the matter may rest. The corporation have now written to the trades council asking whether they would be prepared to receive one or two of the Lyons representatives this year, if it should happen again that all three cannot come.

This sad little story shows the danger to the trade union movement of political differences which in France are no more a matter for compromise and sensible discussion than are wage differentials or problems of demarcation in this country.

Letters to the Editor

ART IN THE MACHINE AGE

Horse of a Different Colour

SIR, In the interesting article with the above title which appeared in your issue dated January 13, you illustrate a 2-4-0 locomotive which forms the subject of a picture included in the exhibition of " Modern Art in the United States," now to be seen at the Tate Gallery.

This picture may have been painted in America but the inspiration appears to have been derived from a European locomotive. The 2-4-0 wheel arrangement was rarely used in the United States until a leading truck with lateral motion was introduced, and even then it was employed in a very few of comparatively small locomotives.

Characteristics pointing to European practice are side buffers of a type used on the Continent, in place of central buffing and drawgear, and the absence of the large headlamp employed on American locomotives of the period, with instead a lamp of Continental type. The outside steam pipes, built-up balance weights, large-diameter driving wheels, six-wheel tender and shrouded cab windows are all out of character in an American locomotive, but in keeping with Continental practice. Further, if the locomotive were American, a cowcatcher, bell, and outside steam chests would certainly be in evidence.

The locomotive cartoonist of the higher order, who has existed since the days of the Liverpool and Manchester Railway, nearly always includes sufficient detail to enable the country of origin of the locomotive to be determined, and often the builder also.

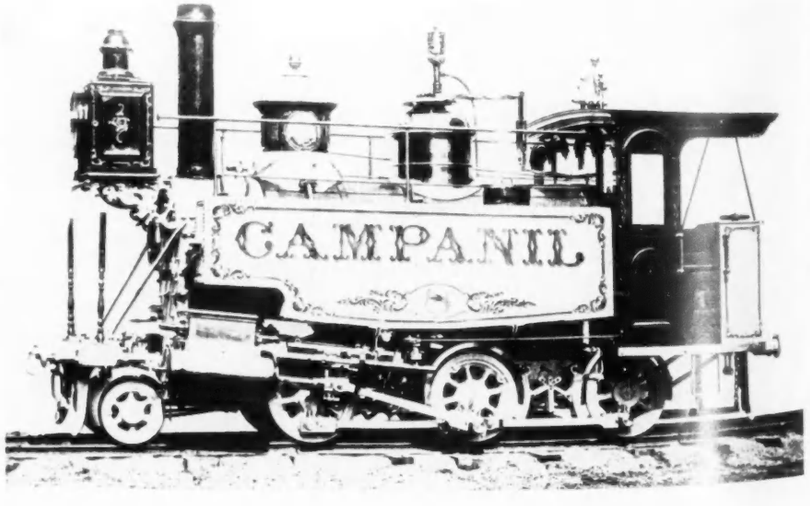
The American painters' art was not confined to canvas—it frequently appeared on locomotives. The accompanying illustration of a Rogers engine gives some idea of the heights to which decoration was carried.

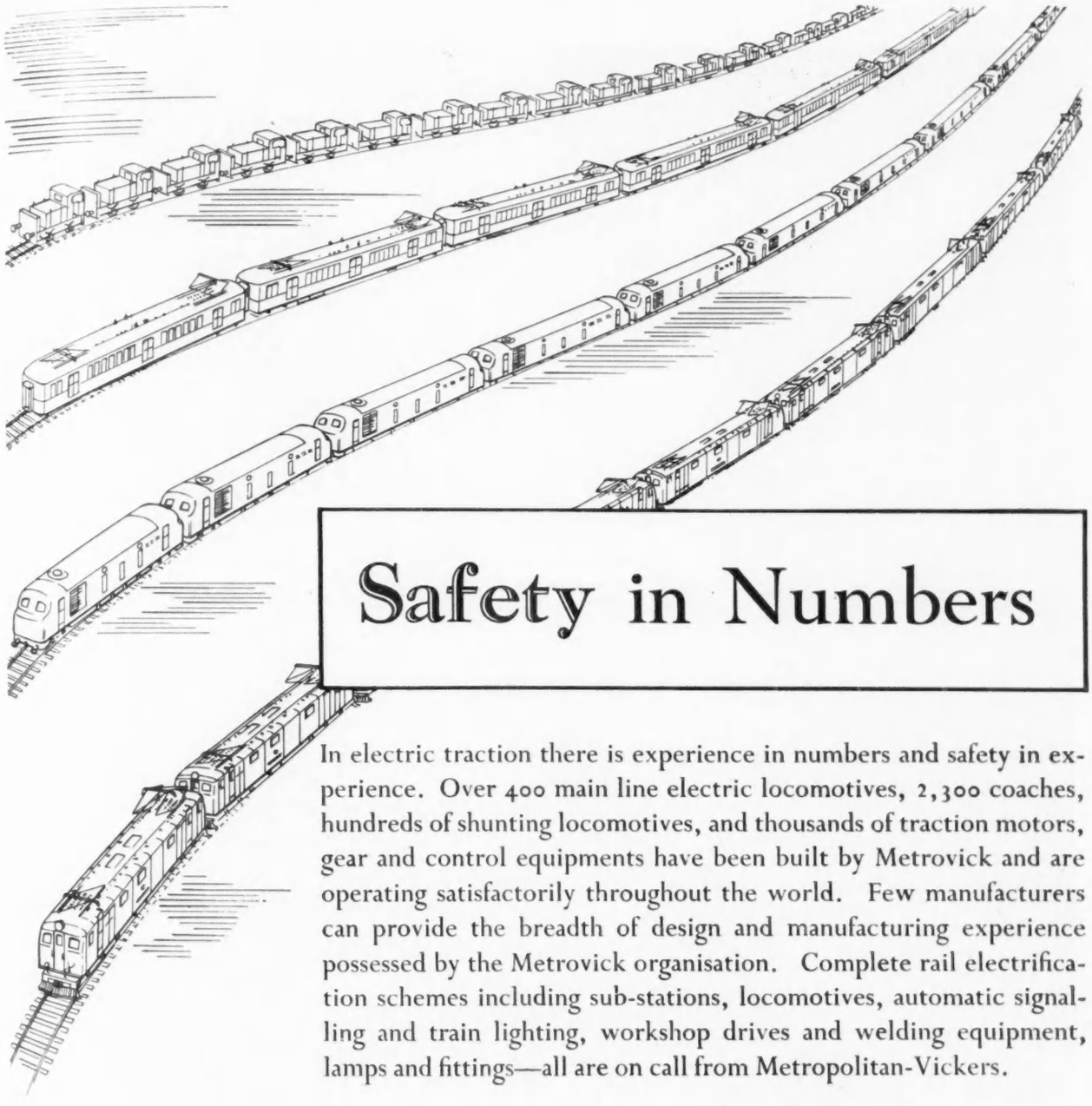
Your faithfully,

C. R. H. SIMPSON.

London, S.W.1.

February 2, 1956.





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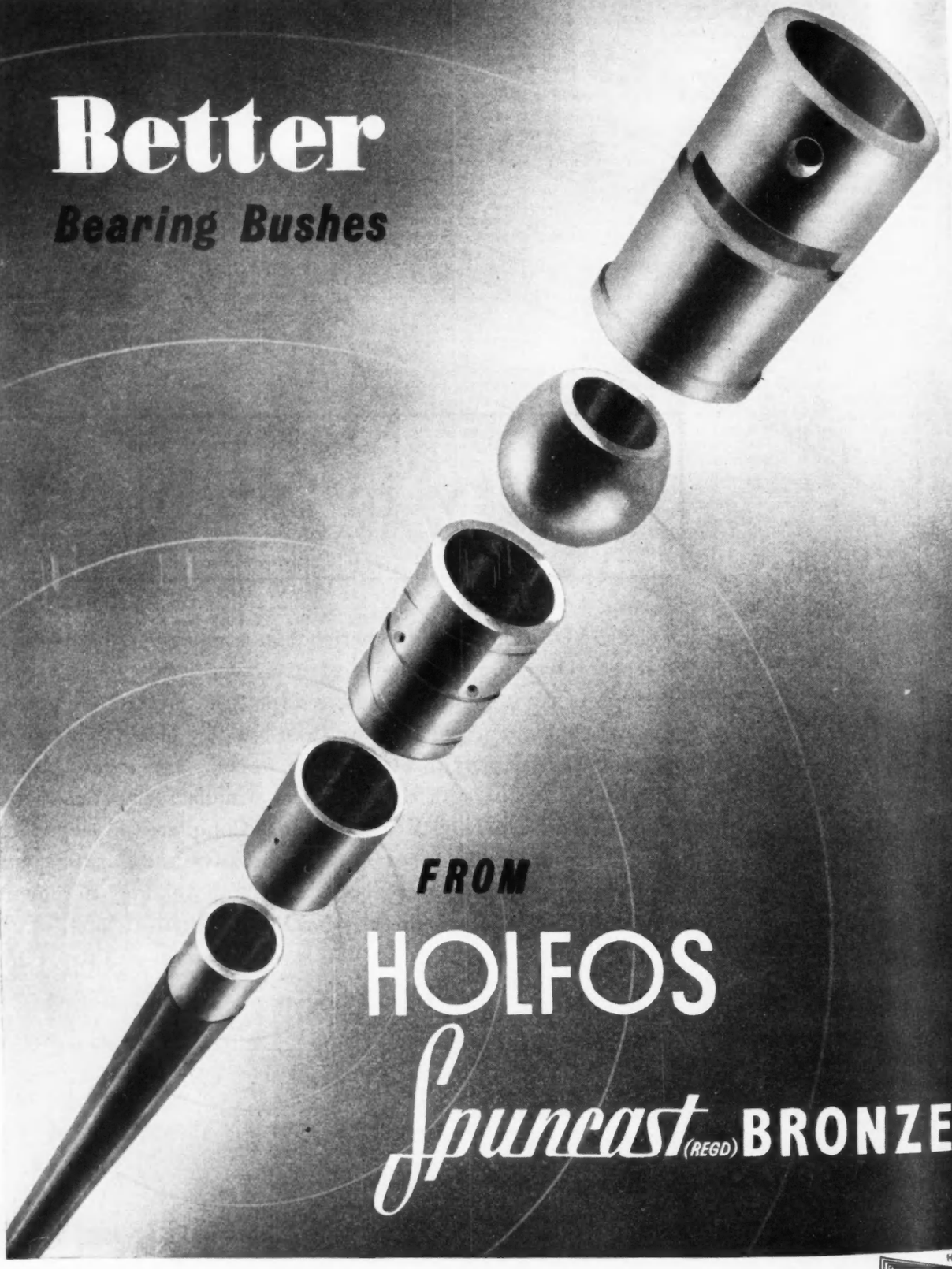

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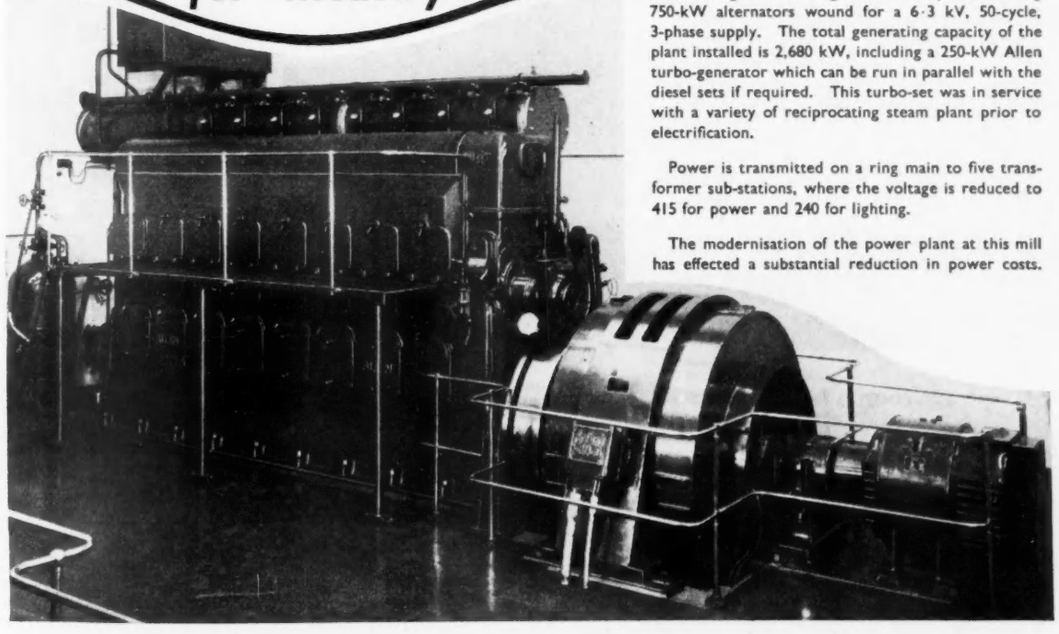

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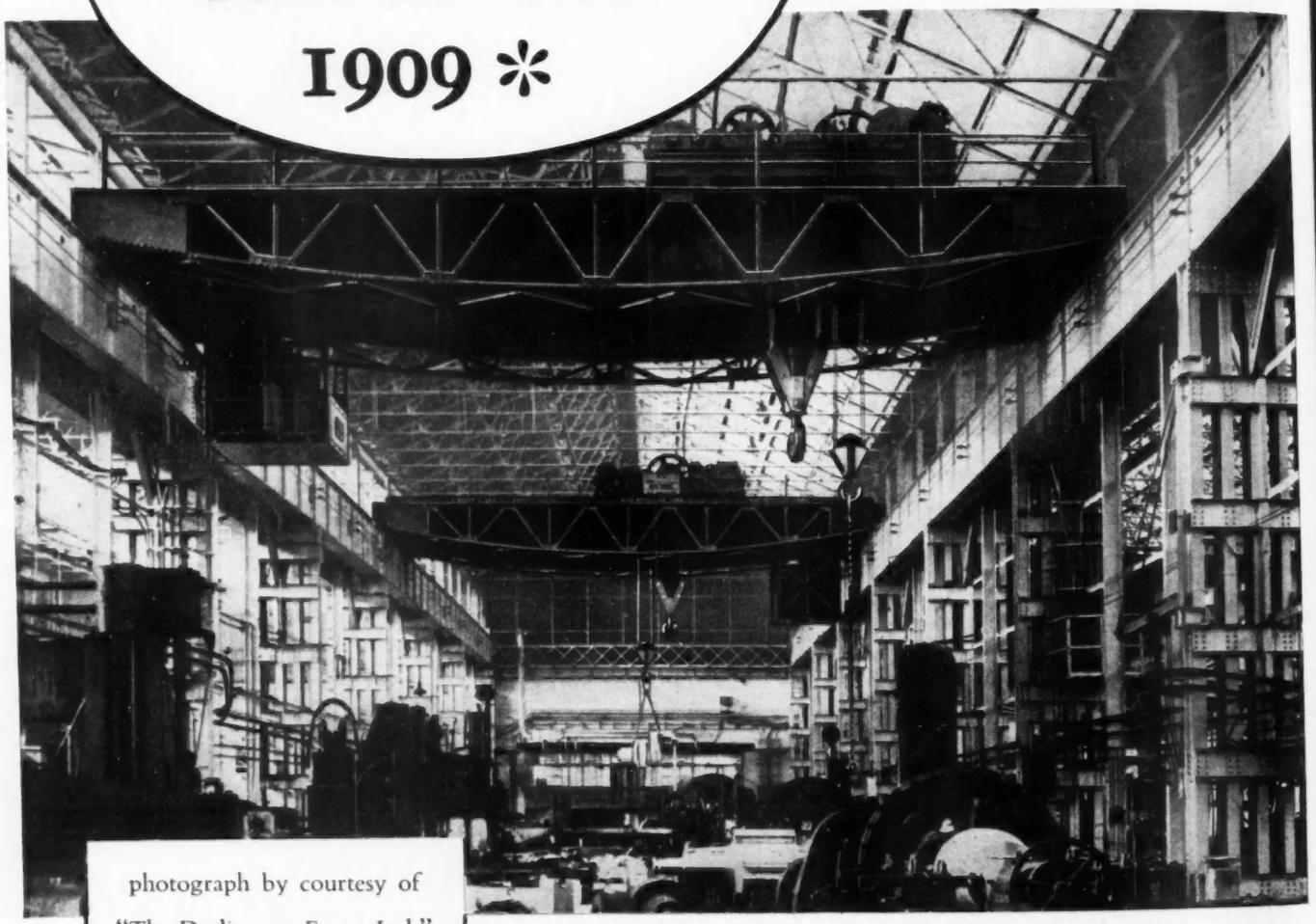

photograph by courtesy of "The Darlington Forge Ltd."

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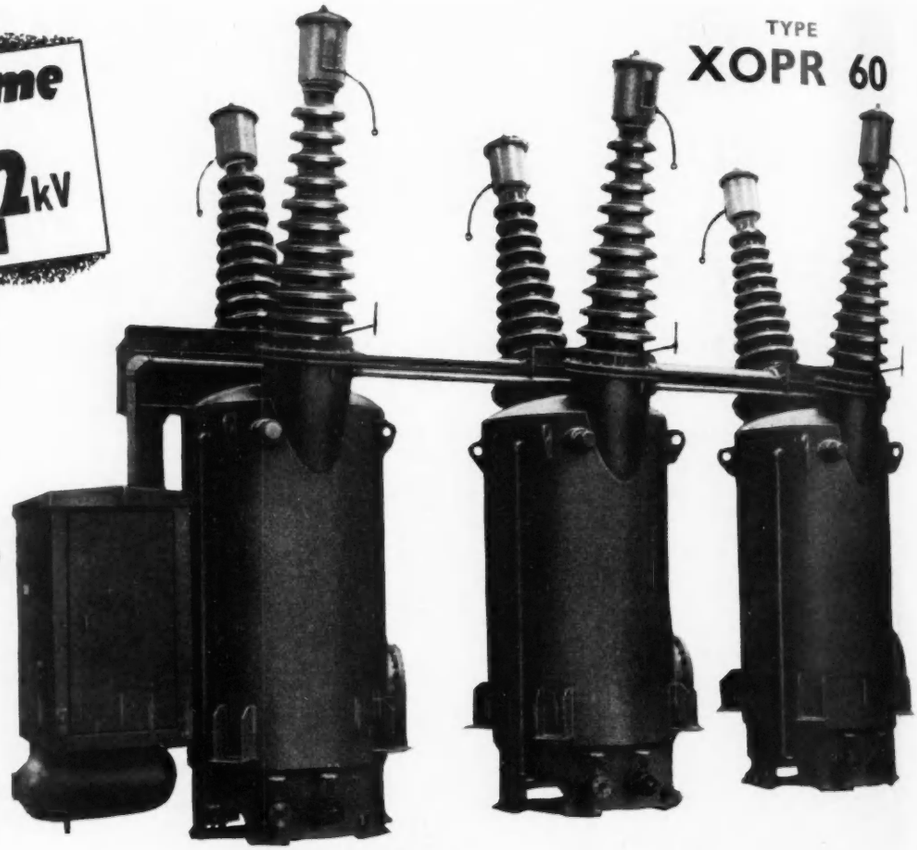

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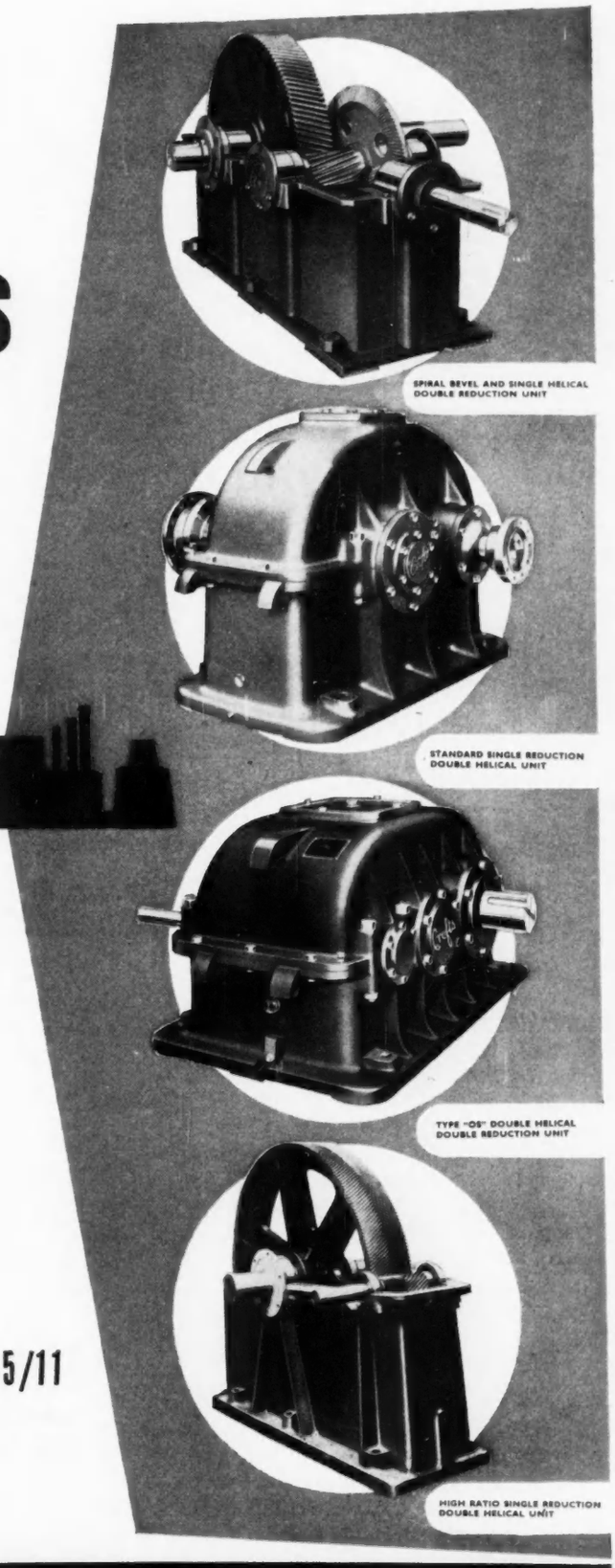

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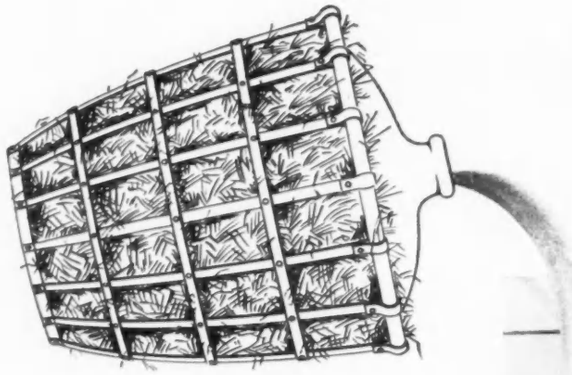

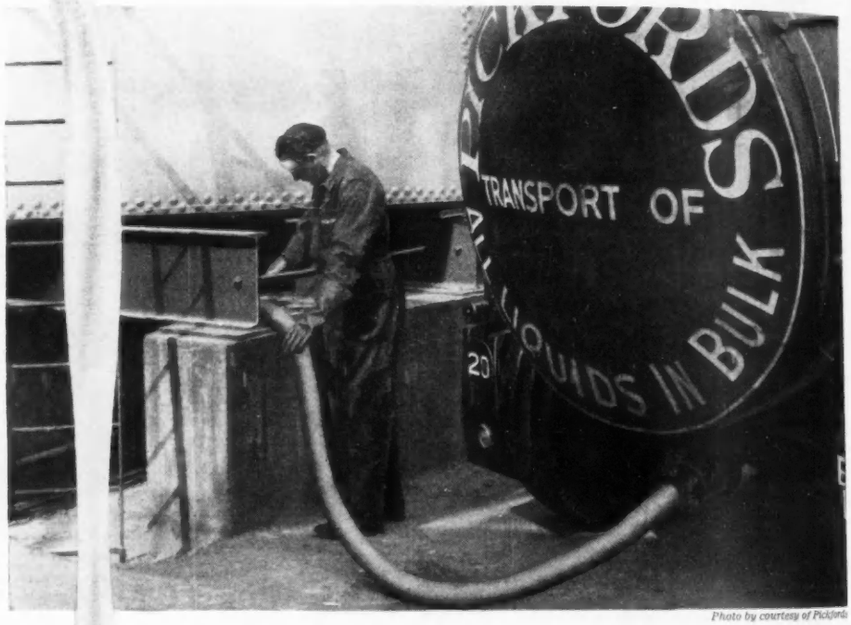

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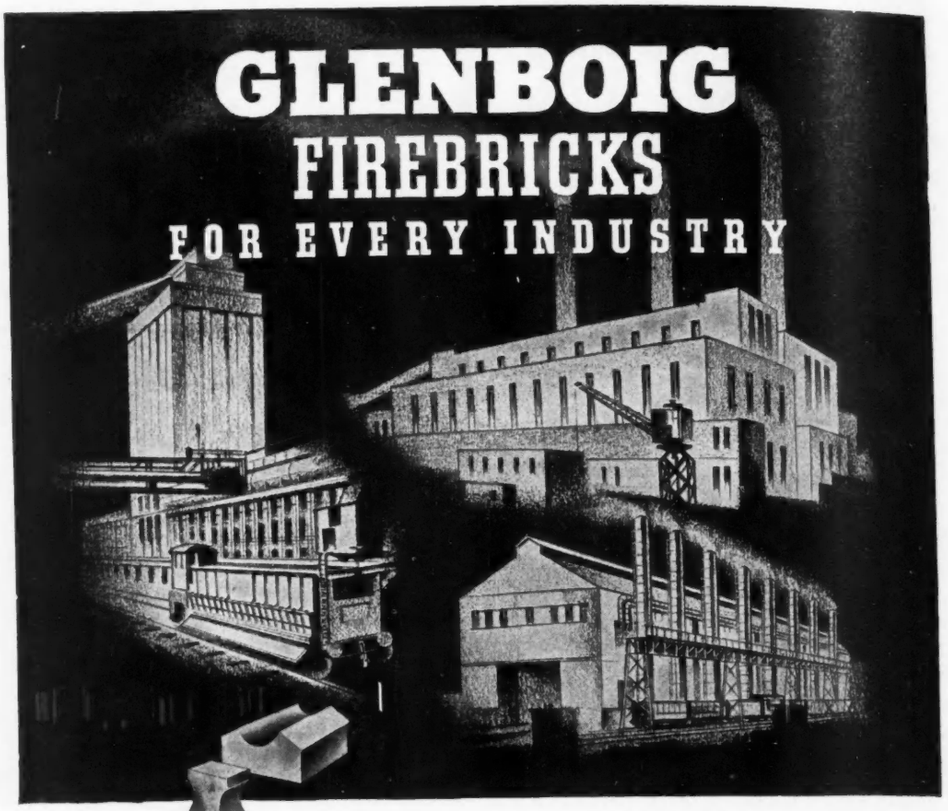

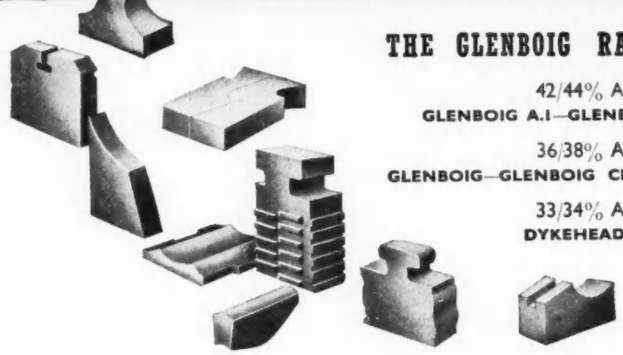

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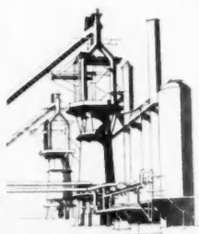

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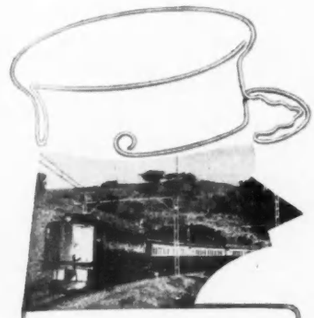

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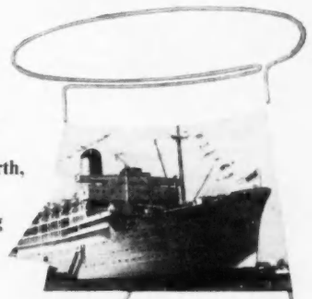

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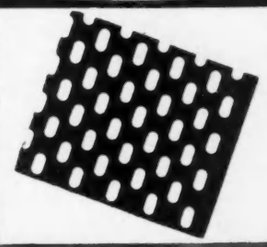

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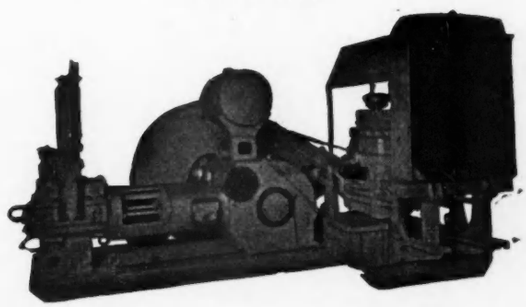

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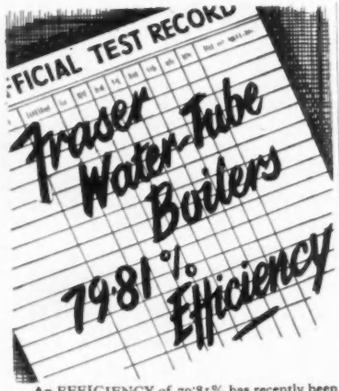

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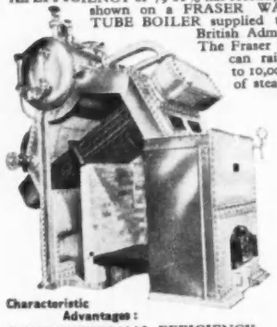

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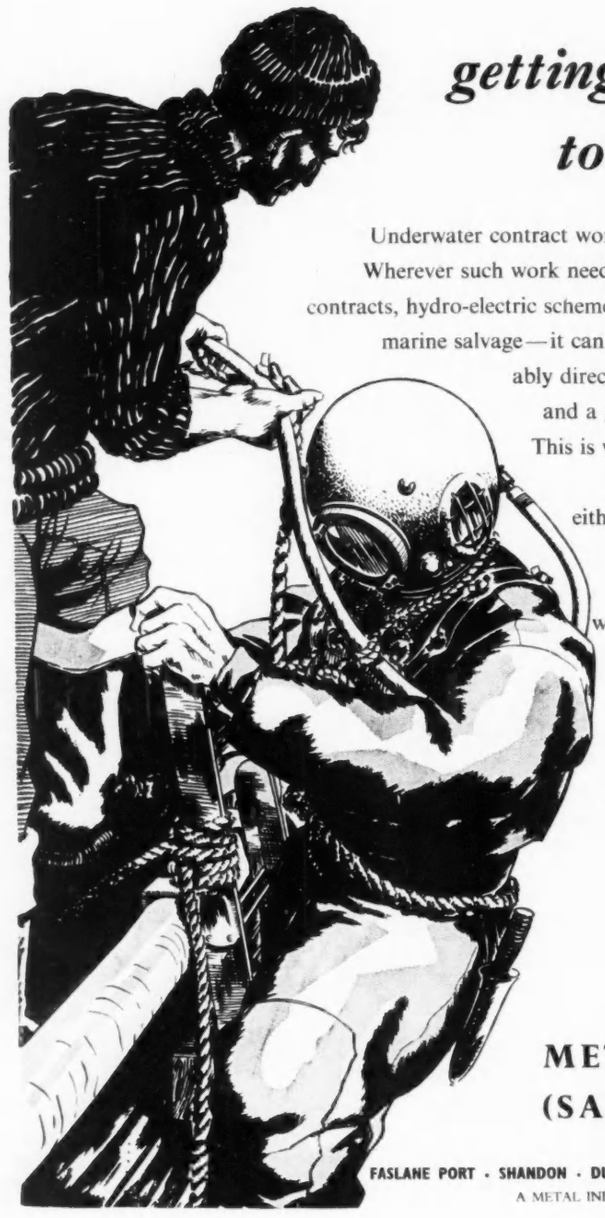

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Classified Advertisements continued from Page 6

OPPORTUNITY FOR YOUNG MEN to receive training in Mineral Water Production. Ordinary National Certificate or equivalent essential. Engineering experience desirable. Interested in Machinery and people. Full-time training leads to supervisory position.—Write for application form and further details to PERSONNEL MANAGER, SCHWEPPES LIMITED, 1-4, CONNAUGHT PLACE, LONDON, W.2. K 355

REQUIRED FOR LARGE OIL REFINERY CONSTRUCTION CONTRACTS IN INDONESIA AND THE MIDDLE EAST.

(a) **AREA SUPERINTENDENTS.** Must be fully experienced in Oil Refinery Construction, able to take control of the erection of individual process units or offsite facilities. (Married accommodation.)

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(c) **OFFICE ENGINEER.** Duties will include preparation of statistics, progress, responsibility for all engineering drawings, co-ordination, etc.

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Only men of sound experience need apply. Good references essential. All jobs except those otherwise stated will require men to serve on bachelor status. Applicants must be willing to go abroad for periods of up to 2 years, be physically fit, of good character, and prepared to co-operate with nationals of the different countries. Good salaries, allowances, and leave credits. Write only: FOSTER WHEELER LIMITED (PERSONNEL SECTION, OIL CONSTRUCTION DEPARTMENT), 3, IXWORTH PLACE, LONDON, S.W.3. K 307

SHELL-MEX & B.P. LTD. have vacancies in their London office and in various parts of the United Kingdom for

QUALIFIED ENGINEERS. Candidates should have had thorough training in Workshops and possess either Corporate Membership of one of the Institutes of Civil or Mechanical Engineers or have passed Parts A and B of one of these Institutions' examination (or have qualifications entitling them to exemption from such examination). Experience on pumps and pipelines or building construction and civil engineering will be advantageous. Starting salary commensurate with qualifications and experience. Excellent Pension Scheme. Applications giving personal details and experience to STAFF MANAGER (REF. D/64), SHELL-MEX & B.P. LTD., SHELL-MEX HOUSE, LONDON, W.C.2. K 312

KELLOGG

INTERNATIONAL CORPORATION

An Anglo-American Company of world-wide repute in the Petroleum and Chemical industries, invites applications for the post of:

ESTIMATING ENGINEER

Applicants must be University graduates and/or members of Professional Engineering Institute, experienced in the petroleum, chemical or allied industries. They must be thoroughly conversant with the equipment used. Age 35-40.

Top salary will be offered based on qualifications and experience.

The Corporation offers excellent personnel benefits, including luncheon vouchers, generous sickness benefits, pension scheme, five-day week, etc.

Only candidates who comply with the above requirements will be considered.

All applications will be treated with the strictest confidence.

Write in the first instance giving particulars of qualifications and experience and enclosing a recent photograph to Dept. 62/H

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78, CHANDOS STREET,
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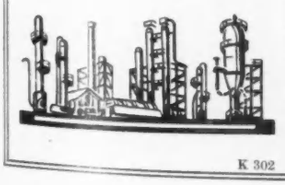

K 302

STRUCTURAL STEELWORK DRAUGHTSMAN required for London office, with at least 3 years experience of Detailing. Five-day week.—Pension Scheme. Apply in writing to the CLEVELAND BRIDGE AND ENGINEERING CO., LTD., 123, PALL MALL, S.W.1., giving particulars of experience, age and salary required. K 318

ELECTRICAL OR MECHANICAL ENGINEERS, AGED 22-30, required as **TECHNICAL ASSISTANTS** for North London Office specialising in the preparation of Estimates, Plans, Wiring Diagrams and Specifications for RAILWAY SIGNALLING SCHEMES for the U.K. and abroad. Applicants should have H.N.C. (Elect. or Mech.) or equivalent and should preferably have completed National Service. Knowledge of railway working an advantage but not essential. Excellent prospects for energetic persons. Five-day week with contributory pension scheme and canteen facilities. Apply in writing stating full qualifications and experience to:—

SIGNAL DIVISION, WESTINGHOUSE BRAKE & SIGNAL CO., LTD., 82, YORK WAY, KINGS CROSS, N.1. K 314

LABORATORY TEST ASSISTANTS aged 22-30, required for Electro-Mechanical Laboratory. Successful applicants should be above O.N.C. standard and have had practical experience of test-bed and laboratory test methods. Work would be mainly on the development and characteristic testing of small carbons and sintered metal components for a wide range of electrical equipment and machines. Write, giving all relevant personal details to the STAFF MANAGER, THE MORGAN CRUCIBLE CO., LTD., BATTERSEA CHURCH ROAD, S.W.11. K 334

Draughtsmen, Draughtswomen and Tracers — Mechanical Engineering.

For Engineering Consultants. Positions are permanent, pensionable, with five-day week. Free lunches. Basic Salary above A.E.S.D. minimum rates, plus profit sharing scheme.

Phone or write, giving details of previous experience, to the

PERSONNEL OFFICER, EWBANK & PARTNERS, LTD., 10/11, GROSVENOR PLACE, LONDON, S.W.1. 200 YARDS HYDE PARK CORNER. SLOANE 0486. G 630

A large firm of Consulting Engineers, London and Provinces, have an important and progressive vacancy for a

SENIOR CIVIL OR STRUCTURAL ENGINEER to take charge of a Department supervising Reinforced Concrete work generally. Extensive outside contracting experience essential. A.M.I.C.E. or A.M.I.S.E. qualification. Age 30-45. Commencing salary £1500 p.a. rising by £100 annually to £2000 and good prospects of further advancement. Permanent and pensionable position. Age and full details of experience to: BOX K 254, Offices of ENGINEERING.

PLANNING ENGINEER (MACHINE) required by progressive and expanding firm in the Automotive Accessory industry in North London. Good general experience essential on up to date methods in batch and mass production. This is an interesting post with a variety of experience.—Apply in writing giving full particulars to: PERSONNEL MANAGER, SIMMS MOTOR UNITS LTD., OAK LANE, EAST FINCHLEY, N.2. K 352

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SUPERINTENDING ENGINEER

Applications are invited for the above post, from persons whose age does not exceed 30 years, and who possess a University Degree or equivalent qualification, in Mechanical and Electrical Engineering, or Mechanical Engineering.

A successful candidate who has not had industrial experience will be required to undergo training, for a probationary period of one year.

Applications should reach the undersigned not later than 1st March, 1956.

Particulars of the salary and other conditions attaching to the appointment, will be supplied on request.

PETER J. MURRAY,
SECRETARY.

7, CLARE STREET,
DUBLIN, C.2. K 322

TEST ENGINEERS required for research work on Two-Stroke Diesel Engines. Applicants should possess a University Degree or hold a Higher National Certificate, and have completed their National Service. Attractive salaries will be paid to suitable men. Please reply in the first instance to BOX K 332, Offices of ENGINEERING.

SENIOR STRUCTURAL STEELWORK DRAUGHTSMAN required for London office. Must have wide experience of Bridge and/or building steelwork and be capable of taking charge of preparation of Detail Drawings.

Five-day week—Pension Scheme.—Apply in writing to the CLEVELAND BRIDGE AND ENGINEERING CO., LTD., 123, PALL MALL, S.W.1, giving particulars of experience, age and salary required. K 319

VAUXHALL MOTORS LIMITED, LUTON, require a

SUPERVISING ENGINEER to work directly under Services Plant Engineer taking complete charge of efficient running and planned maintenance of Boiler Houses (Steam and High Pressure Hot Water approx. total load 600,000,000 BTU/Hr.) Producer Gas Plant and Standby Diesel Generators.

Duties will include compiling accurate records of fuel consumption and maintenance costs, and intelligent interpretation of these to assist future planning.

All plants are modern, semi-automatic and well instrumented.

Successful applicant would have opportunity to familiarise himself with considerable extensions to plant at present in course of construction.

Salary will be according to qualifications and experience.

The Company have a Pension Scheme, good recreational and canteen facilities.

Applications in writing, giving full details of education and experience to:

STAFF EMPLOYMENT MANAGER. K 333

BRITISH PETROLEUM COMPANY LIMITED has a vacancy for an

ENGINEER in its Distribution Department. The work will involve composition and preparation for publication of technical literature covering the application of the full range of petroleum products, the organisation of works visits, lectures and preparation of slides, etc. The applicant should preferably have qualifications approaching A.M.I.Mech.E. Age under 40. A knowledge of a European language would be an advantage, but is not essential. Good opportunities for promotion. Non-contributory Pension Scheme, Luncheon Club. Write giving full details of qualifications and experience, quoting H.3587, to BOX 8606, c/o 191, GRESHAM HOUSE, LONDON, E.C.2. K 317

DRAUGHTSMAN required for Works Office with design experience, preferably including special purpose machinery and tools. Self-contained flat in near vicinity can be provided for suitable applicant. Canteen facilities, pension scheme.—Full particulars of experience stating salary required, in writing please, to THE RAWLPLUG COMPANY, LTD., HALE LANE, MILL HILL, N.W.7. K 316

SENIOR DRAUGHTSMAN required for makers of Machine Tools and Sheet Metal Machines.—apply with age, experience, salary etc. to F. J. EDWARDS, LTD., 359, EUSTON ROAD, LONDON, N.W.1. K 293

ESTABLISHED WEST COUNTRY CO. requires

1. **PLANNING ENGINEER.** Must be experienced practical man with knowledge of machine shop loading, ratefixing and processing. Added experience sheet-metal, welding and fabricating desirable. Salary according to experience.

2. **BOILERMAKER FOREMAN.** Knowledge of pressure vessels, etc., up to ¾ in. plate and welding essential. Must be disciplinarian and preferably able to advise working times.—Write WORKS MANAGER, BOX K 213, Offices of ENGINEERING.

CIVIL ENGINEERS

MERZ AND McLELLAN

CONSULTING ENGINEERS

Invite applications for the following vacancies in their Civil Engineering Design Office at Newcastle upon Tyne.

(1) **TWO SECTION LEADERS** with wide experience both in the design and construction of heavy industrial structures and general civil engineering works. Applicants should hold an engineering qualification.

(2) **DESIGNER/DETAILERS, SENIOR AND JUNIOR,** with previous experience in the design and detailing of either reinforced concrete structural steelwork or general civil engineering works. These vacancies offer good scope for gaining further experience in connection with Nuclear Energy and Steam Power Stations.

The above posts are permanent, a Pension Scheme is in operation and working conditions are good.—Applications quoting reference SAR should be addressed to MERZ AND McLELLAN, CARLIOL HOUSE, NEWCASTLE UPON TYNE, 1.

K 251

DRAWING OFFICE CHECKER wanted for Machine Tool and Sheet Metal Machine Drawings.—F. J. EDWARDS, LTD., 359, EUSTON ROAD, LONDON, N.W.1. K 292

JUNIOR DRAUGHTSMAN required for mechanical and electrical department of Westminster consultants. O.N.C. level or H.N.C. first year helpful and one who has completed National Service preferred. Post is progressive and carries with it staff pensions.—BOX K 331, Offices of ENGINEERING.

BRITISH PETROLEUM COMPANY LIMITED requires a

TECHNICAL ASSISTANT with an Honours Degree in Engineering, Chemical Engineering or Petroleum Chemistry and preferably with practical experience in automobile/diesel or combustion engineering fields. The appointment is of a planning nature connected with quality of petroleum fuels generally and a Degree is not absolutely essential provided other qualifications are acceptable. Non-contributory Pension Scheme. Luncheon Club. Write, giving full details of qualifications and previous experience quoting H.3606 to BOX 8619, c/o 191, GRESHAM HOUSE, E.C.2. K 358

£1500 to £1700 per annum. A Light Engineering Group, already well known in many industries, intends to make its Instrument Factory a major supplier of industrial measurement and process control equipment (mechanical and electronic). They now wish to appoint a

CHIEF ENGINEER to formulate the design of a new equipment. Pension Scheme. Housing assistance if required.—BOX K 350, Offices of ENGINEERING.

PLANNING ENGINEER (ASSEMBLY) required by progressive and expanding firm in the Automotive Accessory industry in North London. Experience in similar situation desirable but not essential. The main qualities required being intelligence, application and drive. Apply in writing giving full particulars to: PERSONNEL MANAGER, SIMMS MOTOR UNITS, LTD., OAK LANE, EAST FINCHLEY, N.2. K 351

THE RESEARCH DEPARTMENT OF METROPOLITAN-VICKERS ELECTRICAL CO., LTD., TRAFFORD PARK, MANCHESTER, 17, has a further vacancy for an

ENGINEER OF HIGHER NATIONAL CERTIFICATE STANDARD or equivalent for practical research and development, in the laboratory and in the works, of a wide variety of machining processes. Some initial training will be given where necessary.

Write for application form to: PERSONNEL MANAGER, METROPOLITAN-VICKERS ELECTRICAL CO., LTD., TRAFFORD PARK, MANCHESTER, 17. Quote reference J.4. G 641

West End London Consulting Engineers require now SEVERAL SENIOR AND JUNIOR ENGINEER DRAUGHTSMEN to prepare designs, contract drawings, specifications, etc., for heating, ventilating, boiler plant and allied mechanical services. Interesting work for factories, office blocks, hospitals, colleges, schools, etc. Opportunity for experienced men with initiative. Five-day week. One week's spring holiday in addition to usual summer two weeks. Bonus and optional superannuation scheme.—Write stating age, experience, qualifications and salary required. BOX G 538, Offices of ENGINEERING.

AUSTRALIA.

TRANSFORMER DESIGNER. Established transformer manufacturer, covering a range from 5-20,000 kVA, wishes to contact capable young transformer designer who already contemplates emigration to Australia. Employment is available in a position offering excellent prospects for the right man. Conditions are good and initial salary would depend on qualifications, but would not be less than £A1250. Write stating age, experience and qualifications to BOX K 353, Offices of ENGINEERING.

INSTRUMENTS. The Chief Engineer of a large manufacturing Company, which is extending its activities in the instrumentation field, will shortly be requiring

SEVERAL ADDITIONAL MEN, preferably aged 26 to 33 years, to undertake important work under the direction of a senior instrument engineer. Candidates, who must have a good degree in Engineering or Physics and at least two years industrial experience in this field, will gain valuable experience in the development of new devices for control of a specialised process and these appointments offer progressive careers to men capable of original thought. The starting salary will be in the range £850 to £1200 per annum according to qualifications. BOX K 279, Offices of ENGINEERING.

GENERAL MANAGER required for medium-sized Engineering Works in Birmingham. Experience in sales organisation, batch production and a high administrative ability is essential. Remuneration by mutual arrangement. Future prospects are attractive to a man of the required calibre. Applicants are invited to write confidentially giving comprehensive particulars to BOX JA/192, c/o, 95, BISHOPSGATE, E.C.2. K 265

Classified Advertisements continued on Page 30

IMPERIAL
CHEMICAL
INDUSTRIES
LIMITED
DYESTUFFS DIVISION

requires

UNIVERSITY GRADUATE ENGINEERS

for training towards senior managerial posts in the development of synthetic fibres. Age 24-30. Previous experience on mechanical engineering design a very desirable basis but consideration will be given to less experienced men or men experienced in other technical spheres. The sequence will be the development, construction and operation of projects embracing new techniques. After joining the staff married men will receive a reasonable refund of removal (including travel) expenses, and to assist them in house purchase, facilities are available in approved cases for loans; in addition, legal charges will be advanced.—Applications with brief details of career to: Staff Department, Hexagon House, Blackley, Manchester, 9. G 640

AN ANGLO-AMERICAN COMPANY of world-wide repute in the petroleum and chemical industries, invites applications for the post of :

ESTIMATING ENGINEER

Applicants must be University graduates and/or members of Professional Engineering Institute, experienced in the petroleum, chemical or allied industries. They must be thoroughly conversant with the equipment used. Age 35-40.

Salary will be from £1750, depending on qualifications and experience.

The Company offers excellent personnel benefits, including luncheon vouchers, generous sickness benefits, pension scheme, five-day week, etc.

Only candidates who comply with the above requirements will be considered.

All applications will be treated with the strictest confidence.

Write giving particulars of qualifications and experience and enclosing a recent photograph to BOX K 360, Offices of ENGINEERING.

EXPERIENCED ENGINEER wanted as **METHODS ENGINEER** for medium-sized Brake Lining Manufacturers. Promotion to Assistant Works Manager in approximately 2 years if suitable. Knowledge of jig and tool design essential. Age preferably 30-40. Commencing salary, £750-£850 per annum, dependent on qualifications. Staff Pension Scheme.—Apply, giving full details of qualifications and experience, to the PERSONNEL OFFICER, BRAKE LININGS, LTD., BUXTON, DERBYSHIRE. K 209

MERZ AND MCLELLAN have vacancies in their Esher Office for

MECHANICAL ENGINEERING DRAUGHTSMEN. Applicants should be experienced in plant layout work preferably, but not essentially, in connection with steam power stations. Salaries will be fully appropriate to applicants' experience starting at about £680 per annum at 25 years. Excellent working conditions. Five-day week. Pension Scheme. Canteen.—Apply in writing to MERZ AND MCLELLAN, MILBURN, ESHER, SURREY. K 207

A Leading Anglo-American design and construction Company of world-wide repute in the Petroleum and Chemical industries, due to expansion, has vacancies for

PROJECT ENGINEERS

The men to fill these posts are the "job architects" supplying the technical information required for design and development of oil refineries and chemical plants—leading their extensive experience to every phase of the project—and maintaining considerable liaison with the customer.

Applicants should be aged 40-45 and must have a good degree in engineering or natural sciences with lengthy experience in basic design problems associated with the petroleum and chemical industries. Full membership of one or more professional engineering institutions is essential.

The right man for the job will know the other requirements in terms of initiative, ability and personality.

The posts are permanent and pensionable and offer first-class opportunity for advancement to men with ambition *and* the ability to succeed. Commencing salary will be in the region of £2000-£2500 per annum. In addition there are generous sickness and other worthwhile personnel benefits.

Applications in detail, giving age, experience and qualifications, together with a recent photograph, should be addressed to BOX K 252, Offices of ENGINEERING.

An Applications **ENGINEER** with experience of drive motorisation and development of associated control schemes, particularly in the steel and coal mining industry, is invited to apply for an interesting and progressive vacancy with BRUSH ELECTRICAL ENGINEERING CO. LTD., LOUGHBOROUGH, LEICS. Applicants should possess an Engineering Degree or a Higher National Certificate. This is an excellent opportunity combining a good salary and first class prospects. Conditions of service include non-contributory superannuation. Please reply to the Chief PERSONNEL OFFICER. K 187

AFRICAN EXPLOSIVES AND CHEMICAL INDUSTRIES LIMITED

Applications are invited for appointments at the Factories and Research and Consulting Engineer's Departments of the above mentioned Company in the Union of South Africa.

The Company's three main Union factories are located near Johannesburg, Cape Town and Durban respectively.

Vacancies exist for :—

(1) **PLANT AND LABORATORY CHEMISTS** with Chemistry or Chemical Engineering qualifications.

(2) **RESEARCH CHEMISTS** with post-graduate qualifications in Chemistry or Physics.

(3) **MECHANICAL AND ELECTRICAL ENGINEERS,** preferably with not less than two years experience since graduation

(4) **INSTRUMENT ENGINEERS** with Electrical (Light Current) or Chemical Engineering qualifications and maintenance and/or design experience in industrial instrumentation.

Further information and application forms can be obtained from H. W. AHRENS, AFRICAN EXPLOSIVES & CHEMICAL INDUSTRIES LIMITED, IMPERIAL CHEMICAL HOUSE, MILLBANK, LONDON, S.W.1. G 634

Seventy-five pounds per month and upwards according to experience offered for **EXPERIENCED DESIGNER** in R.C. as applied to commercial buildings. Pension scheme and a permanent position with an old-established company in their London Head Office. Five-day week. A vacancy also exists for Designer/Draughtsman working under Senior Designer with salary from £50 p.m.—Reply BOX G 587, Offices of ENGINEERING.

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.
ARMAMENTS DIVISION.

Invite applications for the following vacancies in the Assessment Group.

(1) **A MECHANICAL OR AERONAUTICAL ENGINEER** with an interest in vibration problems and aero-elastic studies.

Qualifications should include a degree, and previous experience in this type or work is desirable but not essential.

(2) **TECHNICIANS.**

5 Technicians are required for analysis and interpretation of flight test results.

The essential qualifications would be an Honours degree in Mathematics or Physics, and while previous experience is desirable it is not essential.

(3) **MATHEMATICIANS OR MATHEMATICAL PHYSICISTS.**

2 Mathematicians or Mathematical Physicists are required for interesting work in the Assessment and Aerodynamic Sections.

Applicants should possess a 1st or 2nd class Honours degree, and while previous experience is not essential it would be an advantage.

(4) **TECHNICAL ASSISTANTS.**

A number of Technical Assistants are required for interesting work in the Analysis Section.

The essential qualifications for these posts would be G.C.E. in Maths. or Physics and preferably one year's further schooling in Maths. or Physics.

All these posts offer an interesting and permanent career, together with attractive salaries and opportunities for advancement.

Excellent working conditions and amenities are provided, and an attractive superannuation scheme is in operation. All replies should be addressed to :—

TECHNICAL APPOINTMENTS OFFICER,
SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT, LTD.,
BAGINTON, NR. COVENTRY.
Quoting reference A/2/ARM/TAO. K 330

UNILEVER LTD., require an **ENGINEERING DRAUGHTSMAN DESIGNER** for their London office. Workshop trained. At least O.N.C. standard. Required for the design and planned layout of special factory plant. Candidates should have experience in one or more of the following: (*a*) Steam Plant: (*b*) Material Handling; (*c*) Electrical Wiring; (*d*) Pipe Layouts. Pension Scheme and canteen. Send particulars of age, training and experience in full to: PERSONNEL DIVISION (WAD 108), UNILEVER LTD., UNILEVER HOUSE, LONDON, E.C.4. K 168

SITE ENGINEERS

required for heavy foundation construction contract in North East Coast area.

Apply with particulars to:—
DORMAN LONG (BRIDGE AND ENGINEERING) LTD.,
BRIDGE AND CONTRACTING DEPARTMENT,
38-40, BUTE STREET,
LUTON BEDS
K 195

IMPERIAL CHEMICAL INDUSTRIES LIMITED,
METALS DIVISION.
Vacancies exist for

ENGINEERS

Senior plant design Engineers to co-ordinate the design and development of special-purpose plant, services and facilities in connection with work on the Guided Weapon project. Qualifications necessary are a university degree in Engineering or its equivalent and several years of this sort of practical experience,

and

Junior Engineers to assist in the running of engineering workshops, the organising of plant maintenance and the placing of sub-contracts in connection with work on the Guided Weapon project. Qualifications necessary are H.N.C. or equivalent and several years of practical engineering experience in this field.

The posts afford interesting work in pleasant surroundings with good salaries and conditions of employment. After joining the staff, married men will receive a reasonable refund of removal (including travelling) expenses, and facilities are available in approved cases for loans for house purchase, and advancement of legal charges.

Applications should be addressed to G.S.M., SUMMERFIELD RESEARCH STATION, KIDDERMINSTER, WORCS.

K 125

ASSISTANT STRUCTURAL ENGINEER AND JUNIOR STRUCTURAL ENGINEER

required by

THE STEEL COMPANY OF WALES LIMITED (STEEL DIVISION), ABBEY WORKS, in their Civil Engineering Department.

The Assistant Structural Engineer will be required to organise and be responsible for the maintenance of steel buildings, crane gantries and general structures. His duties will also include the supervision of new steelwork for modifications and building extensions. An ability to organise and supervise labour is essential. Engineering qualifications would be an advantage.

Duties of Junior Structural Engineer will be to assist as above.

The positions are permanent and pensionable.

Those wishing to apply should write for official Application Form to :—
PERSONNEL SUPERINTENDENT,
THE STEEL COMPANY OF WALES LIMITED,
(STEEL DIVISION),
ABBEY WORKS,
PORT TALBOT, GLAM. K 227

SALES ENGINEER (TECHNICAL) required immediately by British affiliate of an American company to operate in Scotland: candidates should be capable of discussing technical problems in association with various processes met with in the fields of metal working, electronics and industrial lubrication: sound technical background up to B.Sc. standard, progressive outlook, proved sales ability and good appearance are essential requirements: the position offers scope for advancement within an organisation and provides interesting technical sales work.—Write, giving full personal details and industrial knowledge, also state salary required and whether owner of a car, to ACHESON COLLOIDS LIMITED 18, PALL MALL, LONDON, S.W.1. K 230

DRAUGHTSMEN required for LIGHTWEIGHT DIESEL TRAIN development work in the London area, also Technical and Sales Assistants for service, Sales and Production Liaison work. Applications in writing stating age, details of training, experience and salary required to: THE GENERAL MANAGER, BRITISH UNITED TRACTION, LTD., 14, HANOVER SQUARE, LONDON, W.1. K 219

A MAJOR OIL COMPANY has an opening in their West African Marketing organisation for an **OPERATIONS ASSISTANT** who should be a graduate in Civil or Mechanical Engineering not over 35 years of age and single. The duties would include preparation of engineering drawings, and specifications, estimates and bills of materials, and the supervision of the erection and installation of such items as building, pump stations, tankage, pipe runs, etc. The commencing salary would be £1080 per annum plus £132 p.a. location allowance. Each tour of duty is eighteen months with three months leave, the position being permanent.—Please apply with full particulars to BOX K 235, Offices of ENGINEERING, marking your letter and envelope WAF.

CIVIL AND STRUCTURAL ENGINEERING DESIGNERS, DRAUGHTSMEN AND STRUCTURAL CHECKERS required for Consultants Offices in Bristol and elsewhere in England and Wales. Must be experienced in one or more of the following: Structural Steelwork for buildings and material handling plants. Reinforced Concrete. Pipework and General Building Construction. Five-day week, optional pension scheme, good salaries and opportunities for promotion by merit.—Reply stating age, experience and qualifications to BOX K 291, Offices of ENGINEERING.

GRADUATE ENGINEERS (MECHANICAL) required immediately for a progressive Chemical Industry located in the North of England.

These vacancies are for design work in the Chief Engineer's Department and are of special interest to young engineers with a flair for design and development work who have served a Graduate Apprenticeship.

The age range is 26-33 and the salary within the range of £1000-£1500 depending upon age, qualifications and experience. There is a scheme for assisting married men with house purchase and removal expenses. Annual bonus and Pension Schemes are attractive.

Applications, which will be treated in the strictest confidence to BOX K 295, Offices of ENGINEERING.

ELECTRICAL DEVELOPMENT ENGINEER required with technical and practical experience of all branches of electrics applicable to aircraft. Must be willing to accept full responsibility and be qualified to carry out an extensive programme of test work and analysis of results. A commensurate salary will be paid.

Full particulars in writing to the CHIEF ENGINEER, THE FAIREY AVIATION CO. LTD., HAYES, MIDDLESEX. K 302

WILTON ICI WORKS

METALLURGISTS

A Metallurgist is required for the Wilton Works of Imperial Chemical Industries. Candidates should possess an honours degree in metallurgy and be under 30 years of age; previous experience is not essential.

Wilton Works is the site chosen by Imperial Chemical Industries as a centre for large scale development. Already fifteen different plants are in production whilst many new plants are being built. The metallurgical work covers investigations on operating plants and on new construction, and includes problems on welding, corrosion, protection of metals, etc. The metallurgical laboratories are new and well equipped.

Wilton Works is situated at the foot of the Cleveland Hills within easy reach of the Yorkshire coast. Working conditions and recreational facilities are excellent.

Schemes for assistance in housing are available, and for house purchase, facilities exist for loans and advances for legal charges; there is also assistance for reasonable removal expenses up to £50.

The appointment is permanent and includes membership of the Staff Pension Fund and participation in the Profit Sharing Scheme.

Write for application form to: Staff Manager, Imperial Chemical Industries Limited, Wilton Works, Middlesbrough, Yorkshire, quoting advertisement reference ICI/X/283/h. K269

PIPING DRAUGHTSMEN required by ASHMORE, BENSON, PEASE & COMPANY, STOCKTON-ON-TEES, experienced in the layout and detailing of requisite pipework for Chemical, Gas, Oil and similar type work. Maximum assistance given in obtaining accommodation. Appointments are permanent by firm where Pension Scheme, Technical Library, Sports and Social facilities have long been in operation.—Apply stating age, experience, etc., quoting Ref. P.F. K 175

AVELING-BARFORD, LTD., GRANTHAM

have vacancies in their expanding Drawing Office for

DESIGNERS AND DRAUGHTSMEN

to work on earthmoving equipment, excavators and contractors' plant. Some knowledge of this class of work is desirable but not essential. Experience on heavy automotive work would be an advantage. —Applications should be addressed to THE PERSONNEL MANAGER. K 223

WANTED

DRAUGHTSMEN to design in aluminium for sales development. Must possess Higher National Certificates in Mechanical Engineering. Location Banbury. Good working conditions and pleasant surroundings. Attractive starting salaries offered up to £800 p.a. with prospects of promotion from drawing board. Pension plan in operation. Send brief details of qualifications and experience to NORTHERN ALUMINIUM CO. LTD., BUSH HOUSE, ALDWYCH, LONDON, W.C.2. G 562

DRAUGHTSMEN (SENIOR AND JUNIOR) required for work in connection with the following branches of Coke Oven and Gasworks plants.

(*a*) Mechanical and By-Product Plant.
(*b*) Pipework.
(*c*) Steelwork for Buildings and Conveyors.

Applicants should be competent men able to work with the minimum of supervision. Technical qualifications to O.N.C. or beyond. Good remuneration and prospects for capable men. Pension scheme. Five-day week; Canteen Facilities.—State age and experience to the PERSONNEL OFFICER (D.O.), WOODALL-DUCKHAM CONSTRUCTION COMPANY LTD., WOODALL-DUCKHAM HOUSE, 63-77, BROMPTON ROAD, LONDON, S.W.3. G 550

ASSISTANT OUTSIDE ENGINEERS WANTED (AGE 23-28). Civil or Constructional Engineering experience essential. Technical qualifications desirable. Good prospects. Permanent posts. Salary according to experience, age and qualifications. Generous out living allowances and leave. Pension, Insurance and Bonus Schemes.—Apply in writing with particulars of education, etc., to THE PERSONNEL OFFICER, WOODALL-DUCKHAM CONSTRUCTION COMPANY, LTD., 63/77, BROMPTON ROAD, LONDON, S.W.3. K 212

CONSTRUCTION SUPERINTENDENT required urgently in connection with the construction of a 200 mile long natural gas pipeline with ancillaries in WEST PAKISTAN. Should be a fully qualified Engineer well experienced in the control of all aspects of large construction schemes and have sound mechanical/civil engineering experience and with a knowledge of the techniques involved in the construction of large bore welded pipelines. The period of construction will be approximately 18 months and the salary will not be less than £220 per month with free board, accommodation and medical attention. First class air passage to and from Pakistan provided but married accommodation is not available.—Write stating age, when available and giving full details of training and experience to BOX E.632, c/o 191, GRESHAM HOUSE, E.C.2. K 218

IMPERIAL CHEMICAL INDUSTRIES LIMITED
METALS DIVISION
invites applications from

DRAUGHTSMEN

to fill the following permanent positions

1. **SENIOR DESIGN DRAUGHTSMAN** with experience of heavy hydraulics, e.g., design and installation of extrusion presses, pumps, accumulators, pipework, valves, etc., operating at working pressures of up to 5000 p.s.i. H.N.C. qualifications preferred but sound practical knowledge essential.
2. **SENIOR DESIGN DRAUGHTSMAN** with good general knowledge of layout and design of mechanical plant, e.g., rolling mills and ancillaries, drawbenches, special purpose plant, materials handling equipment, etc. Work is widely varied and interesting. H.N.C. qualification preferred but sound design experience essential.
3. **SENIOR DESIGN DRAUGHTSMAN** with experience of the layout and design of heating and ventilation installations for industrial buildings including offices. A.M.I.H. & V.E. or equivalent qualification preferred.
4. **SENIOR DESIGN DRAUGHTSMAN** for interesting layout and design work connected with instrument installations applied to a wide range of plant producing non-ferrous metals. Experience to include working knowledge of electronics, electric and pneumatic control systems. H.N.C. qualification preferred.
5. **SENIOR DESIGN DRAUGHTSMAN ELECTRICAL,** experienced in layout of industrial power distribution, automatic control gear and substation work. Knowledge of lighting installations an advantage. Work is interesting, covering a wide range of plant and buildings connected with the production of non-ferrous metals. H.N.C. qualifications preferred.
6. **SENIOR DESIGN DRAUGHTSMAN** for general design work connected with gas and oil-fired furnaces and auxiliary equipment. H.N.C. qualification preferred.
7. **SENIOR DESIGN DRAUGHTSMAN** with good knowledge of pipework layout and detail for steam, water, gas and air services to buildings and plant. H.N.C. qualification preferred.
8. **JUNIOR DRAUGHTSMAN** for general mechanical design and detail work with special reference to safety requirements. Previous experience in this field not essential. The post offers excellent opportunities for gaining experience of a wide range of plant. H.N.C. qualification preferred.

These positions carry good commencing salary and there are excellent prospects for advancement for men with initiative and ability.

Financial assistance towards removal expenses are available for married men. Excellent conditions of employment include Staff Pension Fund, Employees' Profit-sharing Scheme, etc.—Application forms may be obtained from the STAFF MANAGER, I.C.I. METALS DIVISION, KYNOCH WORKS, WITTON, BIRMINGHAM, 6, quoting DR/3/O. K 174

B.T.H.

B.T.H. have immediate vacancies for

TRAINED ENGINEERS in their Industrial Machines Commercial Department at Rugby and Birmingham. These appointments present good prospects for advancement. Applicants should possess H.N.C. or O.N.C. and must have completed their National Service or be exempt therefrom.

All applications with details of experience, qualifications and salary should be addressed to :—

MANAGER,
INDUSTRIAL MACHINES DEPARTMENT,
BRITISH THOMSON-HOUSTON CO., LTD.,
RUGBY. K 167

DESIGN-DRAUGHTSMEN with wide mechanical engineering experience and Detail-Draughtsmen, required, for unusually interesting range of work. Excellent scope in small development D.O. for enthusiastic and enterprising men.—RHODEN PARTNERS, 51, NORTH ROW, W.1. MAYfair 6248. K 180

QUANTITY SURVEYOR required by Consulting Engineers in Birmingham. Staff pension scheme. Please reply in confidence giving qualifications, previous experience, age, etc., to BOX No. 295, GLOVERS ADVERTISING LIMITED, 351, OXFORD STREET, LONDON, W.1. G 595

MECHANICAL AND ELECTRICAL SERVICES ENGINEER required by Consulting Engineers in Birmingham. Permanent post with pension scheme.—Reply in confidence giving qualifications, previous experience, age, etc., to BOX No. 300, GLOVERS ADVERTISING LTD., 351, OXFORD STREET, LONDON, W.1. G 596

DRAUGHTSMAN required for Engineering Department of modern Tar Distillery. Applicants should be of at least O.N.C. standard with General Engineering experience, preferably including plant layout and piping. Varied and interesting work, including some site work. Pension scheme, salary up to £750 per year.—Apply to CHIEF ENGINEER, LANCASHIRE TAR DISTILLERS LIMITED, LIVERPOOL ROAD, CADISHEAD, NR. MANCHESTER. K 149

STRUCTURAL ENGINEER with wide experience of the design and detailing of all types of steel structures and with administrative experience required to act as deputy to the Chief Engineer by large firm of London Consultants. The firm is expanding and the vacancy offers excellent opportunities for the right type of man.—Write in confidence giving details of previous experience and salary required to BOX No. 355, GLOVERS ADVERTISING LTD., 351, OXFORD STREET, LONDON, W.1. G 635

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Manufacturers of Aircraft and Motor Equipment.

Require capable ambitious men to assist in the work of **GAS TURBINE DEVELOPMENT.** Here is an opportunity for men with initiative to obtain a progressive position. The work is extremely interesting and demands a high degree of skill and ingenuity. A generous pension scheme provides an assured future, the working conditions are excellent and full restaurant services are provided. High salaries are paid to the right men.

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Excavator Specialists
invite applications from qualified engineers for appointment as

PRODUCTION MANAGER.

Basic requirements are University Degree in Engineering or Corporate Membership of one of the Professional Institutions plus practical knowledge of modern production systems, the latter is particularly important. This is an interesting and high level appointment in a modern and fully equipped works in the medium/heavy engineering industry.

Interested applicants should write in first instance giving age and all relevant particulars including approximate salary required, to :

PERSONNEL MANAGER,
RUSTON-BUCYRUS LTD.,
EXCAVATOR WORKS,
LINCOLN. K 214

DRAUGHTSMAN FOR MAINTENANCE AND DEVELOPMENT of Seamless Steel Tube Plant. Heavy engineering and Hydraulic experience desirable. Five-day week. Permanent pensionable position to suitable applicant. Special rate will be paid to man of high ability and qualifications.—Write stating full particulars to the CHIEF ENGINEER, STEWARTS and LLOYDS, LIMITED, BROMFORD TUBE WORKS, WHEELWRIGHT ROAD, ERDINGTON, BIRMINGHAM, 24. K 185

ENGINEER DRAUGHTSMAN. AGE 18/25. Required by Company manufacturing Mechanical Handling Plant. The appointment will include preparation Technical Data, Liaison with Manufacturers' Design and Engineering Staff. Five-day week and Superannuation Scheme.—BOX K 197, Offices of ENGINEERING.

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Qualifications: 1½ years' experience in construction of air tools and 2½ in construction of locomotives. Age 32.—Please reply to CIV. ENG. GUNNAR GRANE, POPPELG. 2, MOTALA, SWEDEN. K 328

WORKS MANAGER, M.I.PROD.E. 20 years executive experience telephones, radios, cameras, aircraft, seeks congenial company. South Coast preferred. Age 50. Minimum £1750.—Replies to BOX K 287, Offices of ENGINEERING.

DESIGN ENGINEER, A.M.I.MECH.E., seeks spare time work on design of mechanisms, gearing, instruments.—BOX K 288, Offices of ENGINEERING.

Classified Advertisements continued on Page 32

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ACCURATE MACHINING
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BLISS 306 D SIDED GEARED PRESS, 8 in. stroke, f. and l. pulley drive.
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'Phone: 26311. - - - 'Grams: "Forward."
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Table 7 ft. 3 in. dia. Two swivelling rams, rapid traverses. Seen running in Midlands.
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'Phone: RELiance 3373.
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TWO 16/20 H.P. RUSTON-HORNSBY DIESEL LOCOMOTIVES, 24 in. gauge, in first class condition.
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ONE 400 K.W. SULZER DIESEL GENERATING SET, 220/440 volts, D.C., complete with Auxiliaries, Spares, etc.
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TWO 20 K.W. HILL & CO./DELCO DIESEL GENERATING SETS, 120 volt D.C., 1450 r.p.m., complete with Auxiliaries.
THREE 14 K.W. COVENTRY CLIMAX/MCLURE & WHITFIELD PETROL GENERATING SETS, 230 volt D.C., 1750 r.p.m., complete. Ideal Units for operating magnets on steam cranes. Unused.
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MOBILE CRANES:
3 TONS AND 6 TONS CAPACITY, Diesel Driven, on pneumatic tyred wheels.
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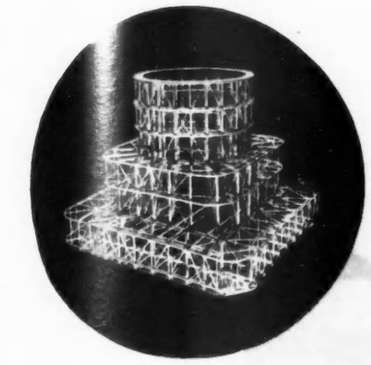

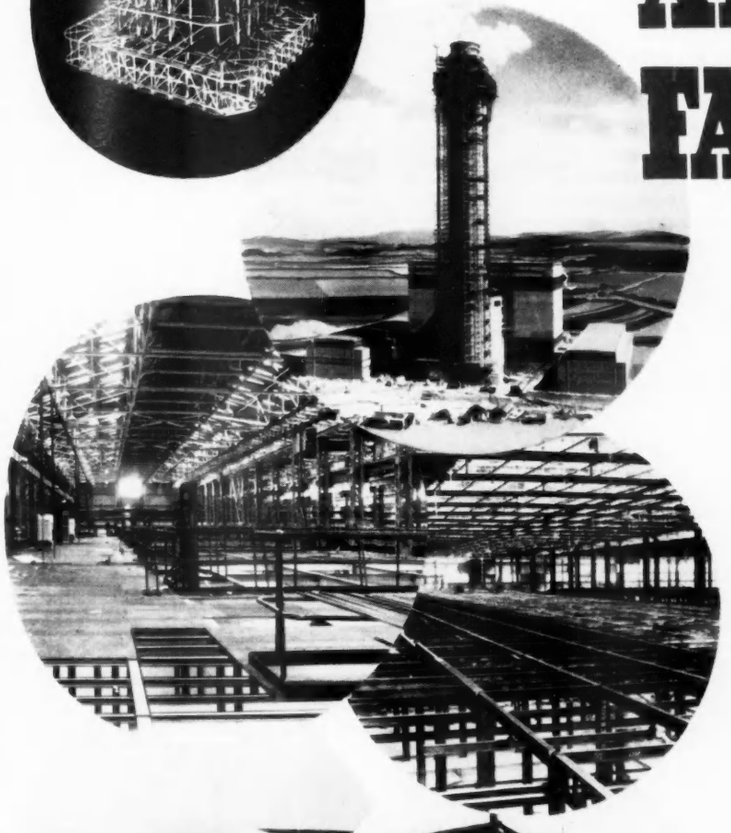

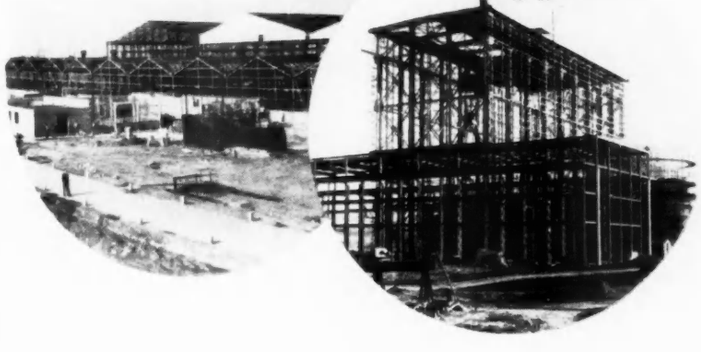

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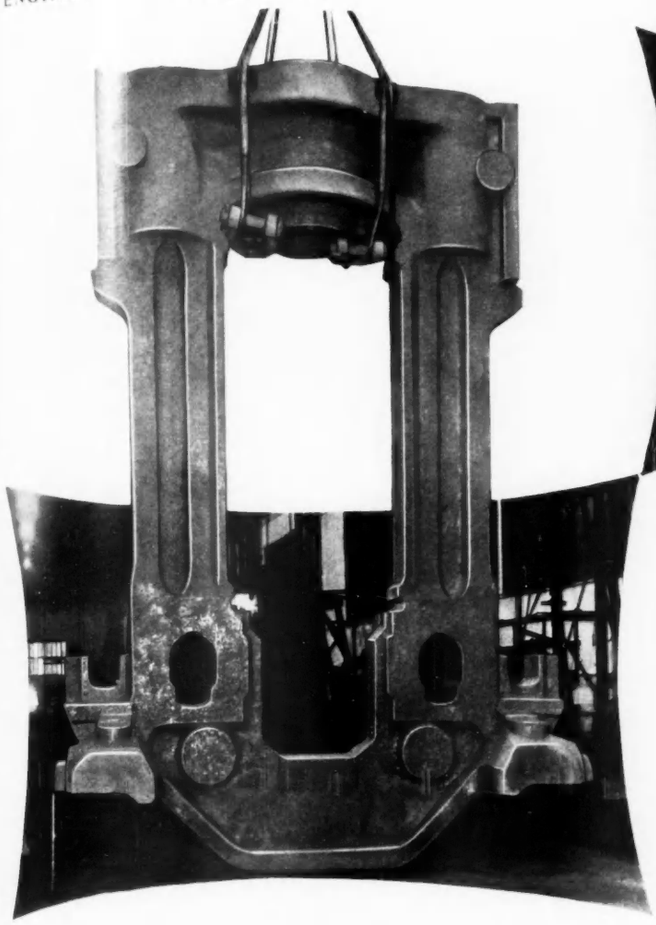

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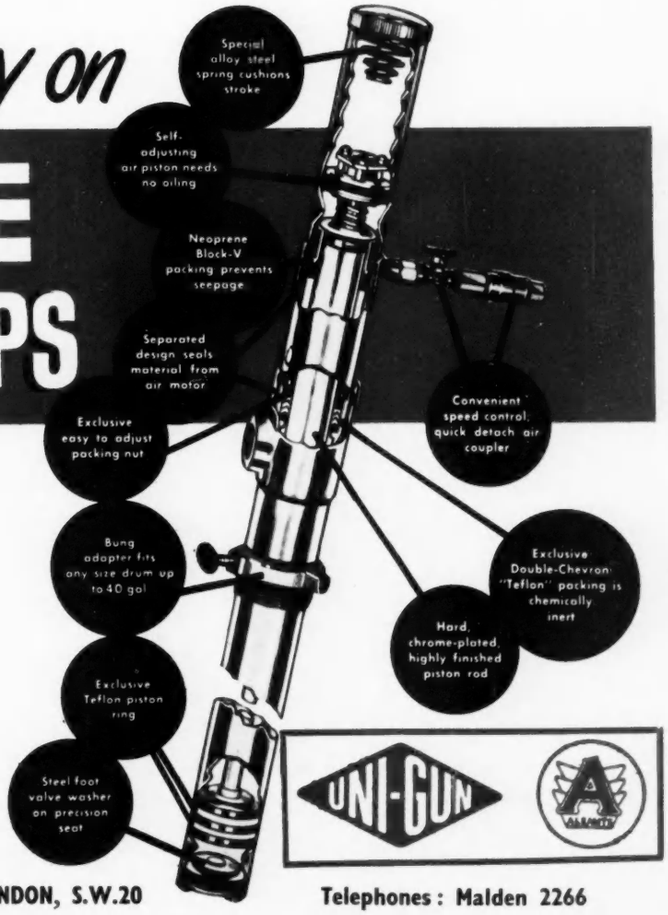
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